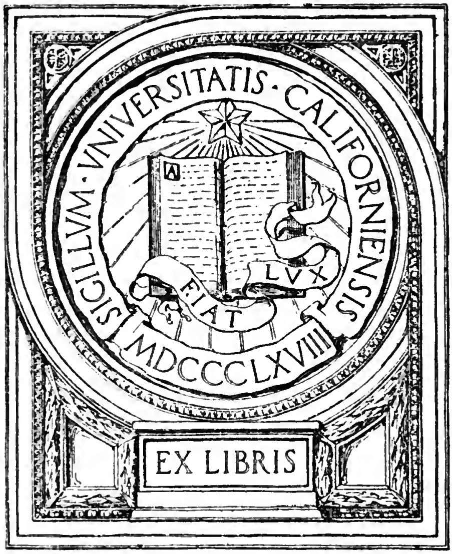
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COURSE OF STUDY

Manual Training Department

OF THE

Elementary Public Schools

CHICAGO

1899 – 1900

PREPARED BY

R. F. BEARDSLEY

SUPERVISOR OF
MANUAL TRAINING

MANUAL TRAINING.

"Manual Training is any form of constructive work that serves to develop the powers of the pupil through spontaneous and intelligent self-activity."—*American Manual Training Association.*

THIS manual is designed as a guide to the teachers of constructive work in the Chicago Elementary Schools. The models shown are such as have proved of value in developing, not alone manual skill, but such as will tend to lead children to independent thinking.

Many forms of hand work are being used as a means of education. They have come to us under various titles. An explanation of the most important forms of constructive work which are used as Manual Training, will perhaps serve as an aid to the further investigation and to a clearer conception of the purposes for which the work is given.

"*The Russian Method*" of tool instruction consists in a series of exercises based upon and accompanied by an analysis of three things: the tools, the materials and the elements of construction. Pieces of wood or other material are made into joints and fittings, each one showing, in abstract form, some mechanical principle.

The training for skill in tool practice, the intimate acquaintance with materials and the study of a limited number of elements of construction, are the basis and aim of this form of Manual Training. Objects of utility are seldom made.

In "*Sloyd*" a series of models is planned by the teacher, each model being a useful object (usually for the home), and each so designed that its execution introduces both a new tool and a new exercise in the use of tools already familiar to the pupil. Progressive training in tool practice and an incentive to careful work is thus attained. The models are usually made pleasing in form and proportion, and the exercises in tool work are arranged to give good physical training. The training of creative powers and the opportunity for self expression are lacking in any form of Manual Training where the finished object or "model" is presented for the pupil to copy.

No name has been found to place in a distinct class that form of Manual Training which is being devised by the combined efforts of technical men and trained teachers. The definition at the head of this article expresses the idea.

The best form of Manual Training is still in a formative stage and will be realized only when the training for skill, the copying of models and the technical features are subordinated to the outworking of the child's imaginative ideals. We must, however, keep ever before us the truism that accuracy and neatness are a part of our patrimony and our patriotism.

No *set* of models can express the manual training idea, nor can any definite course of work be applicable to all of the diverse conditions to be met in one city or even in one school, consequently the courses shown are arranged merely as a base from which to work. Considering that the development of the child morally and mentally is the object of education, then the acquisition of skill, which heretofore has been the dominant feature in manual training, will become incidental, and the exercise of the faculties in self-expression will become the basis for our teaching. Not that the training for skill is to be neglected, but it should not be fostered at the expense of the child's broad understanding of nature and nature's laws.

A closer relation between the work in the shops and the work of the grade teacher is desired in order to give life to the work of the shops, which should be considered as *school laboratories* where the work of the class-room is to be more fully developed. The special teachers of manual training should keep in constant touch with the progress of the grades, and should, as far as possible, plan to have each lesson express in some way the work which is being carried on in the class-room.

Play as a means of education has been shown to be most valuable in our vacation schools and in the Kindergarten. The construction of apparatus for games and plays will be found to bring our work in closer touch with the child's life. Several games shown among the models here presented will illustrate this idea.

Apparatus for scientific experiment and for physical culture opens another field for the development of the inventive faculty.

The making of useful objects, such as are needed in the homes of the children, has heretofore constituted the best form of Manual Training. There seems to exist the necessity for an improvement on this practice, which, even though it gives adequate training for skill and holds the interest of our pupils, fails to ally the work with the life which the children are leading in the school room. The steps necessary to a realization of that which, in our present stage of enlightenment, we would class as ideal manual training, must be gradual in order that the training for skill of hand be not entirely lost to sight. *Manual training should be made serviceable to the school room.*

To this end we have introduced into the course a number of articles dealing with simple apparatus for demonstration in science, in which the tasks for manual work are derived from the theoretic teaching of the schools. Our aim being to educate hand and eye and to use the overcoming of obstacles in forming will-power, we should refrain from using tasks which present no technical difficulties, but should strive to make each object in the simplest possible way. The objects must be presented in regular sequence as regards tool practice, and must therefore be taken, as may seem in rather a random way, from physics, electricity, optics, or mechanics.

Woodwork is sufficient for a two or three years course but is not diversified enough for constructive work throughout the grades. In consideration of this I would advise the use of many materials and would recommend that in planning exercises teachers make use of any material which would be most fitted to the work.* Clay, paper, paper pulp, cardboard, tin, wire, twine and many other mediums may be used alone or in combination with wood to produce the articles or objects desired.

It should always be the aim of teachers to train the judgment of pupils to perceive and appreciate excellence in design, proportion, beauty, and above all, *adaptability to the use intended.*

The directions for work herein given are not necessarily the ones which would be followed by a mechanic in constructing each

*See Constructive Work.

object, but are arranged with the idea in view of a progressive development of the child mentally and physically. These directions are to be carefully followed by teachers, and the tools therein specified are to be used.

EACH LESSON IS, IN GENERAL, TO BE GIVEN IN THE FOLLOWING ORDER:

FIRST: *Theoretical Instruction* as to necessary material and tools, and explanation of the nature and use of the particular exercise.

SECOND: *Drawing.* Free-hand sketching of teacher's model, and constructive drawing made from this sketch.

THIRD: *Demonstration* by the teacher, of the manner in which the object is to be made.

The THEORETICAL INSTRUCTION is to comprise and include descriptions of various kinds of woods and trees, their uses, and the reasons for same. Structure, growth and properties; the methods employed to prepare them for use, defects and their causes, as also the various means employed for preservation.

Tools are to be accurately and minutely described, and the historical development and utility of each particular part is to be made clear. The nature, properties, origin and manufacture of the metals which compose the different implements, is to be indicated, with special reference to steel in its relation to iron, and how to harden it. *The sharpening and care of edged tools is to be taught at the time of their introduction into the work.*

The COURSE IN DRAWING will be given as follows:

In the case of objects made from one piece of thin wood, where but one view is required, no drawing is to be made. Pupils will under these conditions work from the teacher's model, and from a blackboard drawing.

In the case of all objects requiring two or more views for their representation, pupils will in every case make a free-hand sketch from the teacher's model, showing the *necessary* views and dimensions, except where otherwise indicated in the directions.

This sketch, after being approved by the teacher, is to serve as a basis for the finished working drawing. The pupil should be taught that this class of drawing is a convenient and forcible means of thought expression.

No drawings will be required of "extras" or such objects as are to be made by those pupils who are in advance of the class. Blue prints will be furnished for this class of work.

In the case of *all* regular or class-work the teacher is required to DEMONSTRATE, BEFORE THE ASSEMBLED CLASS, the methods to be pursued in constructing the object under consideration.

The successive steps in the execution of the exercise are to be indicated and demonstrated. This includes all operations necessary to the production of the finished article, the use of the various tools, the testing and marking of completed faces. Difficult points in the exercise should be anticipated by the teacher, who will emphasize the means to be taken to avoid or overcome them, and cautions previously given regarding the holding and using of edge tools should be repeated.

Individual demonstration is to be given upon anything but the pupil's work, which is to be entirely the product of his own skill.

Hasty and careless work should be early detected and corrected. This being possible if it is required that each of the steps in the exercise be executed and submitted for inspection before further work is undertaken.

Ornamentation in the form of background punching and chip-carving is introduced to develop artistic feeling and to cultivate the inventive faculty. Therefore, in giving this work avoid as much as possible the copying of designs shown in this pamphlet. These designs are intended merely as suggestions. Stimulate the pupils to plan their own designs, which when properly criticised and corrected by the teacher, will in most cases prove effective.

As a means of awakening the interest of children we have found nothing better than to allow them to plan some form of ornamentation and execute it as an "extra."

Work which is not a pupil's best effort should never be decorated. Neither should ornamentation be used to hide defective workmanship.

Sandpaper should be used only to clean the work. It is never to be considered as a cutting tool, nor used to remove irregularities in tool work.

Putty is to be used *only* to cover the heads of nails or screws which are set or countersunk.

The steel scrapers are for use on hollows and rounds. They may be classed as cutting tools.

ACCIDENTS.

"Slight wounds are liable to occur in the course of the manual training work, and should be managed in accordance with the methods of modern aseptic surgery, not only for the immediate benefit of the one injured but for the educational value derived from extending a knowledge of such methods. Teachers are therefore urged to follow accurately the following instructions, which so far as they go may be considered to represent the methods followed by the advanced surgery of the day."

"First all foreign material or dirt must be kept out of wounds. By the word dirt is meant anything capable of bearing such micro-organisms as produce pus or blood poisoning. Such organisms are constantly present in the air, and upon all substances exposed to the air, such as handkerchiefs, tools, the skin, etc., also in water, except that which has been purified by recent boiling. The individual who takes charge of a wound should first carefully wash his hands, then wash the wound with recently boiled water, or with water which has been purified by passing through a germ-proof filter such as the Pasteur. In washing a wound never wash anything into it, but always away from it. Then without touching the fingers to the wound cover it with some of the purified (sterilized) gauze found among the supplies. The gauze should be thickly massed over the wound, care being taken to avoid having that portion of it which immediately covers the wound come in contact with the fingers, clothing, table, or anything else which has been exposed to the air. The gauze should then be fastened down over the wound by a bandage, or where convenient by a piece of adhesive plaster."

"In removing the gauze from the jar, cut off what is wanted with a pair of clean scissors, and immediately close the jar, exposing the contents to the air as little as possible."

"When the bleeding is slight it serves to cleanse the wound partially and is not dangerous. The pressure from the bandage, which should never be excessive, will in the great majority of cases be found to be sufficient to control the bleeding. Cobwebs and other infected material should never be used to stop bleeding. When bleeding is excessive it can be controlled by tying a bandage around the limb involved, at some place where the tissues are soft, and tightening it if necessary by twisting it with a ruler."

DIRECTIONS

FOR

MANUAL TRAINING TEACHERS.

During the school year of 1899 and 1900 teachers in the Manual Training Department will conduct the work in the shops in accordance with the following directions:

1. On all school days teachers are to be present in their shops from 8.30 A.M. to 12.00 M., and from 1.00 P.M. to 4.00 P.M., unless excused by the principal. Teachers of Manual Training may remain in their shops until 5.00 P.M. on school days, and on Saturdays while the janitor is in the building, (see proceedings of the Board, Jan. 25, 1899, page 452).

2. SUPPLIES (including lumber, sundries and tools), to the maximum amount of one hundred dollars ($100.00) will be furnished to each shop. The cost of each item of supplies is shown in the supply list. Teachers are cautioned to so regulate their orders that they may never be in danger of overdrawing.

3. Any *changes* in the course of study, or plans for the construction of apparatus not shown in this book are to be submitted to the Supervisor for approval before construction is begun.

4. (*a*) In order that a suitable exhibit may be made of the work in your shop, you will keep the entire product of one class in each exercise. You will thereby have a representative collection of work at the end of the year, and will have deprived each class of but one piece.

(*b*) None of the articles made are to be distributed to pupils until they have been inspected and approved by the Supervisor of Manual Training.

5. The extras are to be made only by such pupils as have satisfactorily made the regular exercise and have finished the same ahead of the majority of the class.

6. FINISH. Not more than two coats of shellac are to be applied to any exercise, except where specifically directed in this course of study.

7. Pupils' work, either finished or unfinished, when left by them, is to be destroyed, and is never to be given to other pupils, because in that case they would be tempted to display as their own the work of others.

8. Tools are not to be loaned from the Manual Training shop either to teachers or other employes of the Board of Education; carpenters in the employ of the Board of Education are, however, to be allowed to use the grindstone at times when the Manual Training teacher is present, provided this use of the stone in no way interferes with or infringes the rights of the classes.

9. Tools are to be inspected by the pupils of each class at once upon their arrival, and a report made to the teacher as to defect or shortage. Pupils are required to replace all tools lost or broken by them, and also in cases where neglect to report leaves the fixing of responsibility open to dispute. (Teachers will be held accountable for all tools and apparatus under their charge.)

10. Sharp Tools. Extra plane-blades are furnished in sufficient quantity so that no pupil should be required to sharpen blades that have been dulled by others. Dulled or nicked plane-blades should be reported upon entrance of the class, and the blades kept for those to sharpen who have dulled them.

11. Each exercise is to be *made by the teacher* in the presence of the assembled class.

12. A copy of your program is to be placed upon the blackboard in your shop.

13. The order of several of our shops during the past year has not been ideal. Please see that your shop presents a neat and tidy appearance at all times.

14. Varnish, glue, stain, etc., are not to be used at the benches. (A respect for tools and equipment is one of the important things to teach the boys.)

15. All absences of teachers are to be reported immediately by them to the Supervisor, together with an explanation of the cause.

16. A letter file is provided for use in your shop. This is to be hung in the shop, and in it you are to preserve all communications from this office, except such as may be of a personal nature, not relating to your school work, or such as are returnable to this office.

17. Wood handscrews are not to be used until properly lubricated with a mixture of oil and graphite.

18. (*a*) Gas is to be used for *illumination only*, except by special permit signed by Supervisor of Manual Training.

(*b*) Gas is to be used economically, and is to be turned off when not in actual use.

(*c*) Pupils *must never* be allowed to light the gas; this is to be done by the teacher.

19. Teachers are to call personally for salary checks.

20. Report blanks are furnished in order that a daily report of absence, or tardiness may be made by you to the principal of each school sending pupils to the Manual Training Shops. (A report is to be sent with every class.)

21. All drawings are to be preserved and arrangements are to be made by you for the display of the best ones both in the shop and class rooms.

COURSES OF STUDY.

For many classes these courses will be found too long; in some cases teachers will realize that repetition in certain processes is unnecessary and that, therefore, several models may be omitted. There are models in each course which would interest pupils in one part of the city, but would be of no value in another.

Teachers are therefore directed to use care and judgment in following the outlined courses. The boys' ingenuity to plan and devise new forms of apparatus or ornamentation should be stimulated and encouraged. The choice of alternative exercises is to be made by the teacher.

FOUR YEAR COURSE.

Beginning in Fifth Grade.

1. Ruler No. 1, p. 19.
2. Pencil Sharpener No. 1, p. 18.
3. Twine Winder No. 1, p. 16, or Paper Folder, p. 22.
4. Letter Opener No. 1, p. 25, or Pen Holder, p. 43.
5. Round Mat, p. 31, or Bread Cutting Board, p. 35.
6. Mat No. 1, p. 23, or Ring Toss, p. 24.
7. Box Kite (if in season) p. 34, or Pencil Box No. 4, p. 107.
8. Key Rack, p. 38, or Paper Knife, p. 41, or Envelope Case, p. 36.
9. Picture Frame, p. 71.
10. Coat Hanger, p. 38.
11. Nail Box No. 1, p. 49, or Match Safe No. 4, p. 28.
12. Whisk Broom Holder No. 1, p. 51, or Comb and Brush Pocket No. 2, p. 55.
13. Book Rack No. 1, p. 57, or Pedestal No. 2, p. 133.
14. Bracket Shelf, p. 59, or Bootjack, p. 73.
15. Tipcat and Bat, p. 63, or Shinny-stick and Block, p. 39.
16. Window Box (For the School, not to be given to the pupil), p. 131.
17. Stamp Box, p. 69, or Book Rack No. 2, p. 58.

18. Towel Roller, p. 91.
19. Sled, p. 98 or 99, or Aquarium, p. 84, or Drawing Board, p. 78.
20. Pen Tray, p. 100, or Nature-study Kit, p. 131.
21. Picture Frame, p. 71, or Snow Shovel, p. 118.
22. Inlaid Hat Rack, p. 83, or Umbrella Stand, p. 127.
23. Sugar Scoop, p. 110, or Match Safe No. 5, p. 29.
24. Glove Box, p. 111, or Book-binding Outfit.*
25. As a final exercise allow each PUPIL to select some model not previously made.

THREE YEAR COURSE.

Beginning in Sixth Grade.

1. Ruler No. 1, p. 19.
2. Pencil Sharpener No. 1, p. 18.
3. Twine Winder No. 1, p. 16, or Paper Folder, p. 22.
4. Round Mat, p. 31, or Bread Cutting Board, p. 35.
5. Mat No. 1, p. 23, or Ring Toss, p. 24.
6. Coat Hanger, p. 38.
7. Nail Box No. 1, p. 49, or Pencil Box No. 4, p. 28.
8. Picture Frame (For the School, not to be given to the pupil), p. 71.
9. Book Rack No. 1, p. 57, or Waste Paper Basket, p. 112 *et al.*
10. Salt Box No. 2, p. 75, or Tipcat and Bat, p. 63.
11. Whisk Broom Holder No. 2, p. 51, or Stamp Box, p. 69.
12. Towel Roller, p. 91.
13. Sled, p. 98 or 99, or Drawing Board, p. 78.
14. Pen Tray, p. 100, or Nature-study Kit, p. 131.
15. Knife Box, p. 105, or Inlaid Hat Rack, p. 83.
16. Sugar Scoop, p. 110, or Book-binding Outfit,* or Pedestal No. 1, p. 56.
17. As a final exercise allow the CLASS to select some one of the models not previously made.

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* See chapter on Book Mending.

TWO YEAR COURSE.

Beginning in Seventh Grade.

1. Ruler No. 2, p. 19.
2. Mat No. 1, p. 23, or Bread Cutting Board, p. 35.
3. Coat Hanger, p. 38, or Pen Holder, p. 43.
4. Envelope Case, p. 36, or Foot Stool No. 1, p. 102.
5. Stamp Box, p. 69, or Salt Box No. 1, p. 74, or Book Rack No. 2, p. 58.
6. Picture Frame, p. 71, or Knife Box, p. 105.
7. Towel Roller, p. 91, or Nature-study Kit, p. 131.
8. Sled, p. 98 or 99, or Aquarium, p. 84, or Drawing Board, p. 78.
9. Pen Tray, p. 100, or Book-binding Outfit.*
10. Selected by the TEACHER, according to the ability of the individual.

ONE YEAR COURSE.

Beginning in Eighth Grade.

1. Ruler No. 2, p. 19.
2. Mat No. 1, p. 23, or Bread Cutting Board, p. 35.
3. Envelope Case, p. 36, or Nail Box No. 1, p. 49.
4. Book Rack No. 1 (oak), p. 57, or Bracket Shelf, p. 59.
5. Picture Frame (For the School, not to be given to the pupil), p. 71.
6. Knife Box, p. 105. or Stamp Box, p. 69, or Whisk Broom Holder No. 2, p. 51, or Drawing Board, p. 78.
7. Selected by the TEACHER, according to the ability of the individual.

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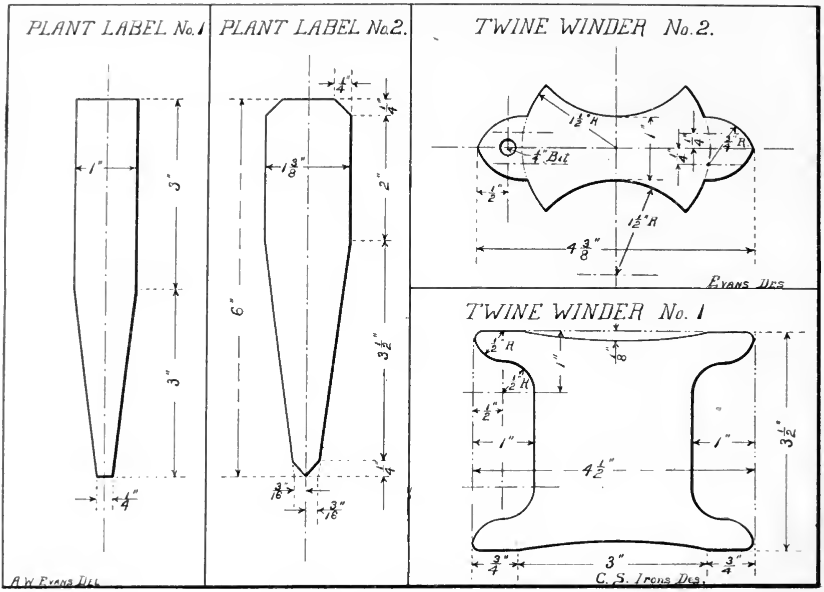
* See chapter on Book Mending.



PLANT LABEL, No. 1 or No. 2.

Prepare stock 1/8″ or 3/16″ x 1 1/4″ x 7″, s. 2 s., Bass.

1. One edge is to be made straight and smooth by the teacher.
2. Pupils will square one end with knife (cross whittling). To be tested with trysquare.
3. Measure length and square around with knife.
4. Whittle to knife line and test with trysquare.
5. Gauge width and cut to line. (Straight whittling.)
6. Measure and mark small end with pencil and rule.
7. Whittle to oblique lines. (Oblique whittling.)
8. Clean all over with No. O sandpaper on a block.

No Drawing.

TWINE WINDER No. 1.

Prepare stock 3/16″ x 4″ x 5″, Basswood (grain running long way), with tried edge.

1. Whittle one end square to the tried edge (holding piece in hand and cutting straight across).

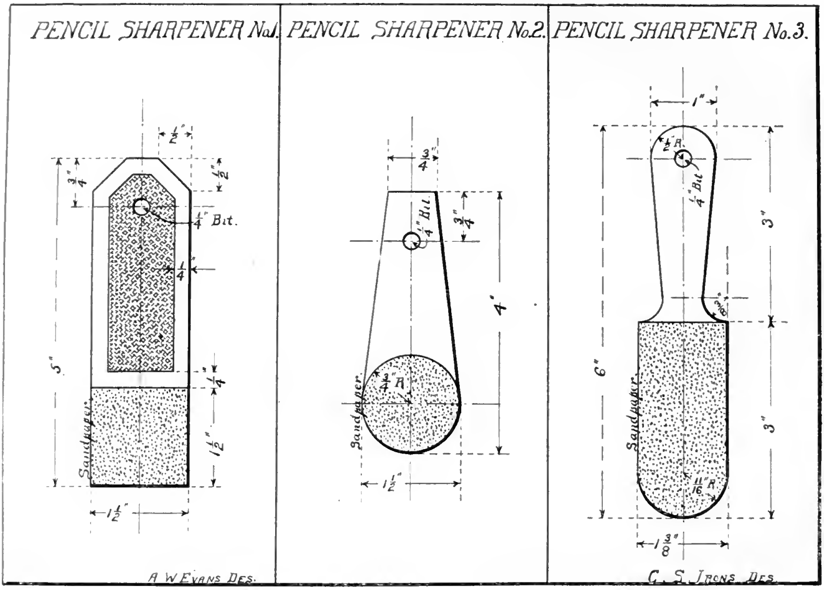
2. Measure length ($4\frac{1}{2}''$) from this finished end and square across with knife line.
3. Whittle this end square to tried edge.
4. Measure off widths ($3\frac{1}{2}''$) and whittle to line. (Be careful to note direction of grain and whittle accordingly.)
5. Mark the outline as per drawing.
6. Start cutting out the ends, working down in center until reaching straight line at bottom, then cut the curves, working from bottom up, thus working with the grain.
7. To cut out curves in sides first cut V in center to prevent splitting, then work from both ends toward the center.
8. Finish all over with No. O sandpaper. No shellac or varnish used.

TWINE WINDER No. 2.

Stock, $\frac{1}{8}''$ or $\frac{3}{16}''$ x $4\frac{1}{2}''$ x $5''$, s. 2 s., Bass.

1. Draw a pencil line through center of board in direction of grain.
2. Draw line at right angles to above at its center.
3. Measure and mark curves.
4. Saw nearly to lines with coping-saw.
5. Finish with half-round file and sandpaper.

No Drawing.

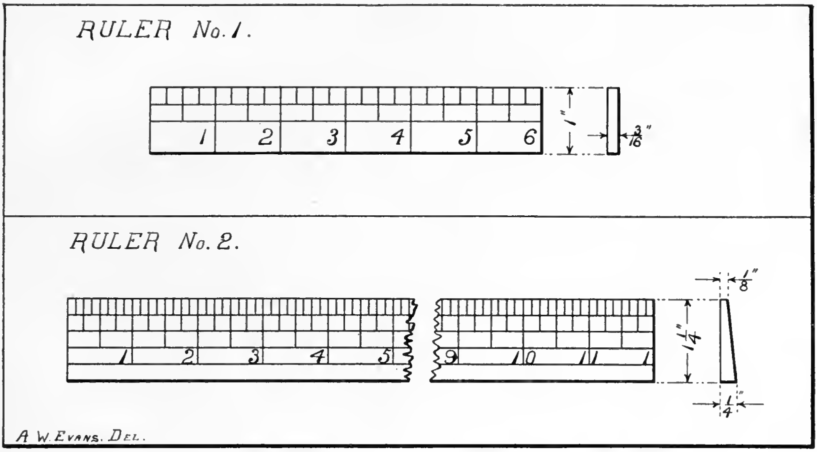


PENCIL SHARPENERS.

Stock, 1/8" or 3/16" x 2" x 5", s. 2 s., Bass, prepared by teacher.

1. One edge to be made straight and smooth by teacher.
2. Square one end. (Cross-whittling.)
3. Measure length and square that end.
4. Gauge width and cut to line. (Straight-whittling.)
5. Mark curve with drawing compass.
6. Cut to curve with knife. (Curve-whittling.)
7. Measure and mark small end with pencil and rule.
8. Cut to oblique lines. (Oblique-whittling.)
9. Locate and bore hole.
10. Give pupil a small piece of No. O sandpaper from which he will cut the disk or square to be glued on. (Clean all over with No. O sandpaper on block before gluing.)
11. Use wooden hand-screw and a piece of waste wood in gluing on sandpaper.

No Drawing.



RULER No. 1.

Stock, $\frac{3}{16}$" x 1½" x 7½", s. 2 s., Bass, prepared by teacher.

1. Plane working edge.
2. Square line across face about ¼" from end.
3. Saw off with backsaw, being careful that inside edge of saw is at center of line.
4. Measure length and square line across face.
5. Same as 3.
6. Measure width at both ends and draw line between these points.
7. Plane to width.
8. Sandpaper clean.
9. For lines parallel to edge, measure distance at each end and draw lines with *sharp* pencil. For cross lines, measure carefully and draw lines using pencil and trysquare.

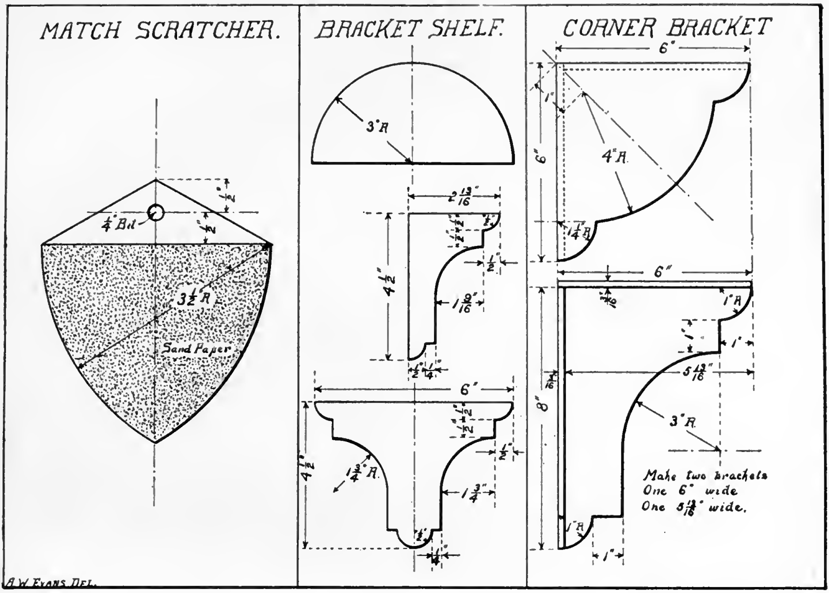
RULER No. 2.

Stock, 1" x 1½" x 12½", Rough Pine.

1. Plane working face and working edge.
2. Gauge the parallel lines shown on drawing ¼" apart.
3. If gauge lines are defective, replane working face and gauge again.

4. Beginning about ¼″ from end mark the lines for inches, using trysquare and knife.
5. Mark the half inch divisions.
6. Mark the quarter inch divisions.
7. If all is correct, plane the rough edge to first gauge line.
8. Gauge the thickness on edges and plane the reverse side to these lines.
9. Saw to length, number with pencil and clean with sandpaper.
10. The lines and divisions may be remarked with a sharp pencil before the ruler is shellaced.

NOTE.—The eighth inch divisions should only be attempted by very skillful pupils.



MATCH SCRATCHER.

Stock, 1/8" or 3/16" x 4" x 5", s. 2 s., Bass.

1. Draw center line and lay off curves and diagonal top lines.
2. Cut to curves and straight lines with knife.
3. Glue on a square piece of No. O sandpaper.
4. Cut to curve when dry.
5. Bore hole.
6. Finish with sandpaper on block.

No Drawing.

BRACKET SHELF.

Stock for Top, 3/16" x 6½" x 3½", s. 2 s., Bass.
Stock for Brace, 3/16" x 3½" x 5 ", s. 2 s., Bass.
Stock for Back, 3/16" x 6½" x 5 ", s. 2 s., Bass.
Make each part a separate exercise.
Use pencil, rule, compass, coping-saw and half-round file.

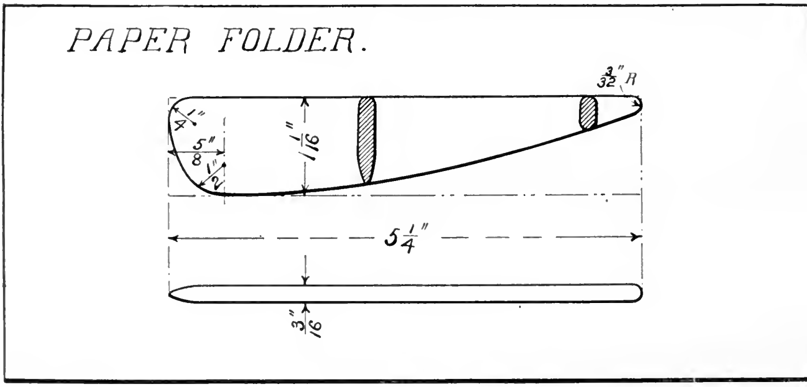
When the three parts are correctly finished and *cleaned* with sandpaper, fasten back and brace together by means of glue and brads, having pupils locate and start the brads before applying the glue. Give particular directions to apply glue very sparingly and have all superfluous glue cleaned off before it hardens.

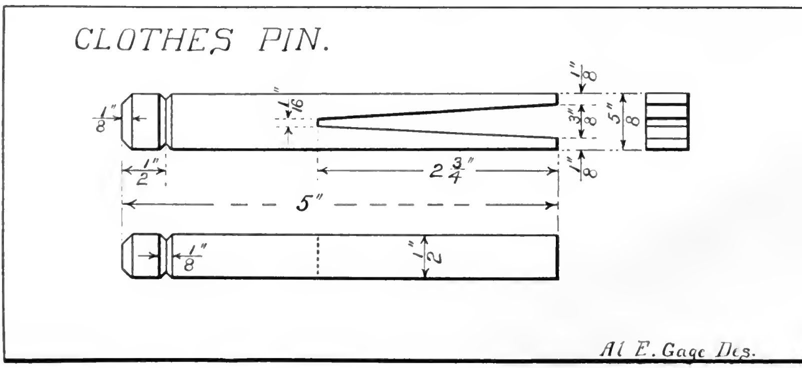
Locate and start brads in top and fasten with glue to back and brace.

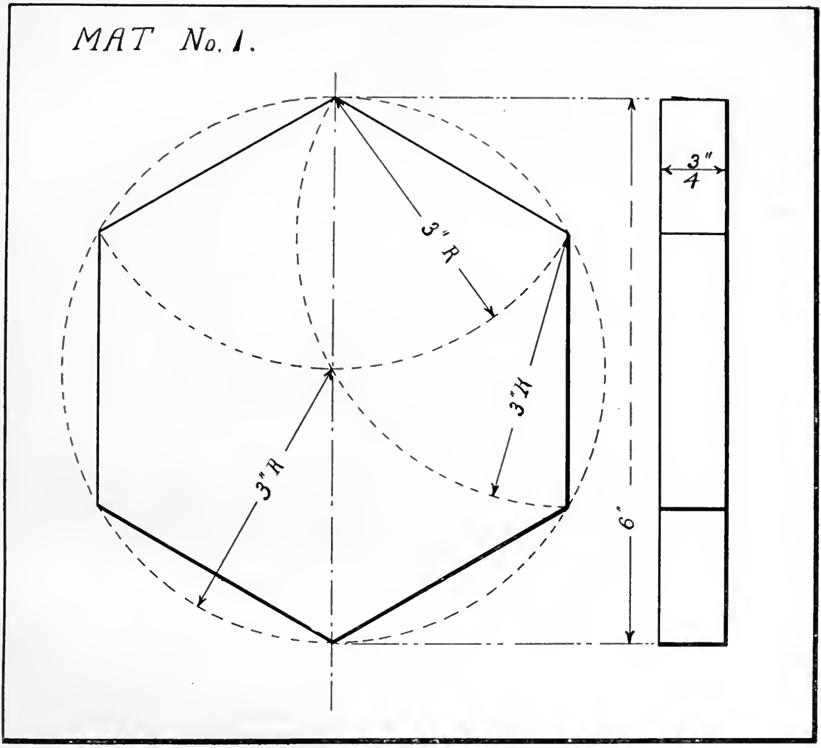
No Drawing.

CORNER BRACKET.

Stock for Top, $\frac{3}{16}''$ x 7″ x 7″, s. 2 s., Bass.
Stock for Braces, $\frac{3}{16}''$ x 7″ x 9″, s. 2 s., Bass.
Same steps, tools and directions as for *Bracket Shelf.*
No Drawing.







MAT No. 1.

Stock, 1″ x 8″ x 8″, Rough Pine.

First have each pupil saw off a piece 8″ long, then plane and finish according to directions. A set of models such as are shown on page 66 for the sandpaper block are a great help in directing this work if it is used as a first planing exercise or if given as an extra. This method of showing processes is not to be carried beyond the first year's work.

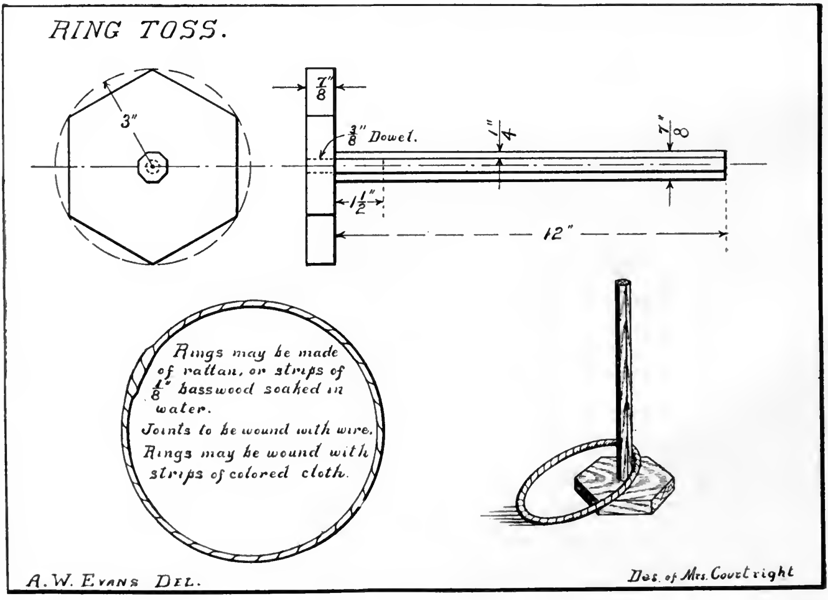
A blue print of the following directions may be placed before the pupil, or they may be printed on the blackboard.

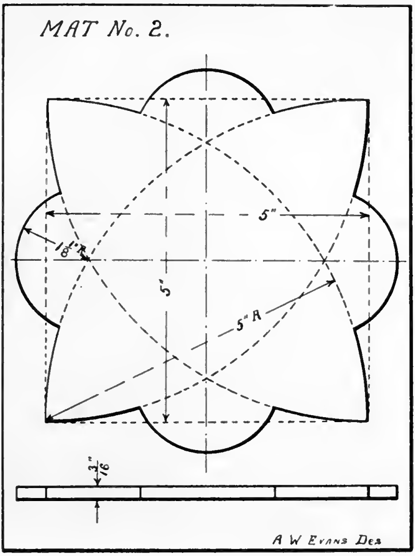
1. Plane the working *face* and mark it X.
2. Plane the working *edge* and mark it II.
3. Chamfer a *corner* [ask teacher which one.]

4. Plane this *end* square with working *face* and working *edge*.
5. Measure the length from this planed *end*.
6. Square across with knife-line.
7. Saw off *end* just beyond the knife-line.
8. Chamfer a corner opposite tried *edge* and plane this *end* to knife-line.
9. Gauge the *width*.
10. Plane the *rough edge* to gauge-line.
11. Gauge the *thickness* on edges and ends.
12. Plane the *rough face* to gauge-lines.

Drawing as shown.

NOTE.—Be sure that the pupils thoroughly understand the meaning and the distinction between the words which are printed in italics.



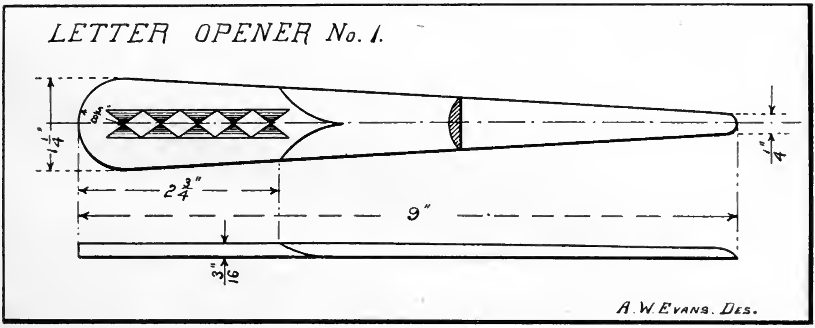


MAT No. 2.

Stock, 1/8" or 3/16" x 6½" x 6½", s. 2 s., Bass.

1. Plane edge and end square, using shooting-board.
2. Mark five inch square, with knife-lines.
3. Lay off curves, and saw with coping-saw.
4. Finish to lines with knife.
5. Design a background for punching.
6. Lay off design, cut lines with knife, and clean before punching.

No Drawing.

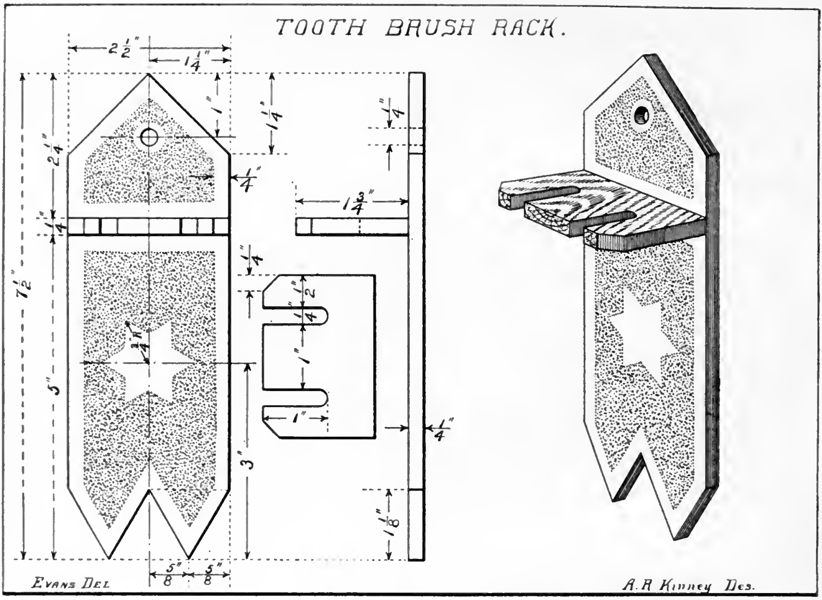


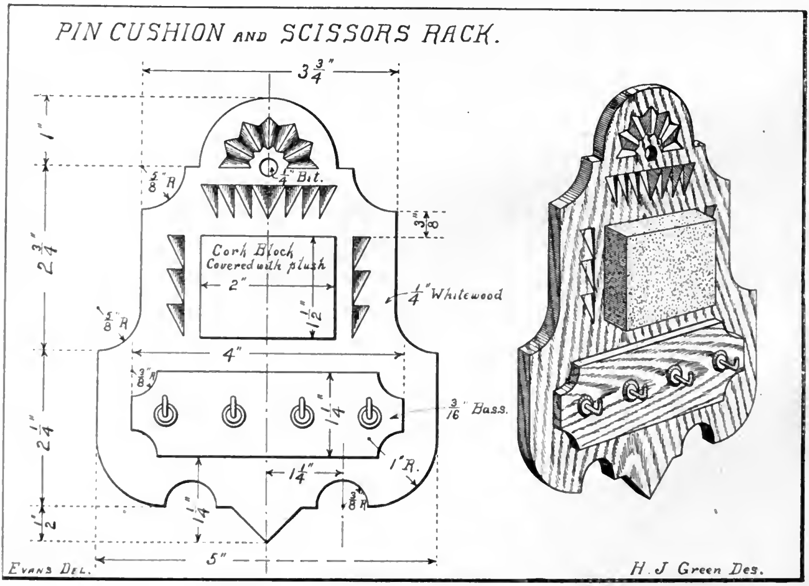
ENVELOPE OPENER No. 1.

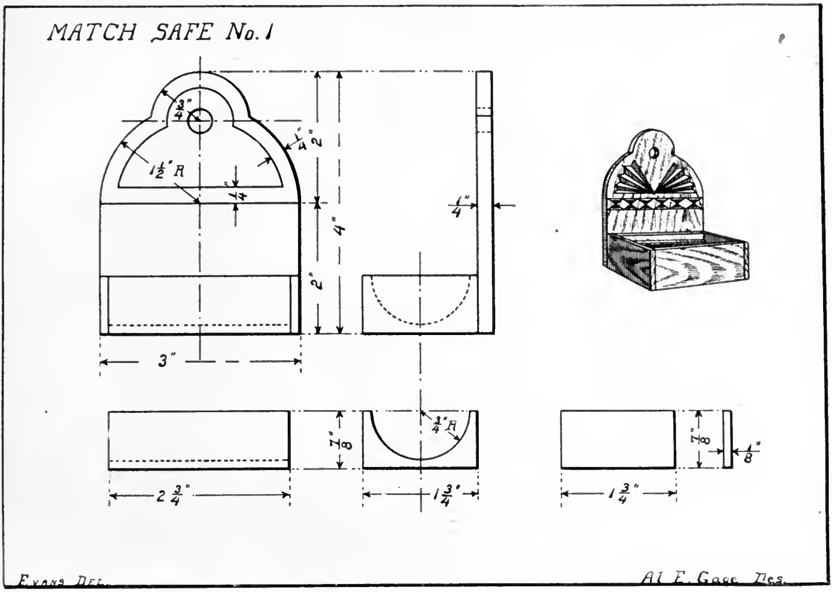
Stock, 3/16" x 1¼" x 7½", s. 2 s., Bass.

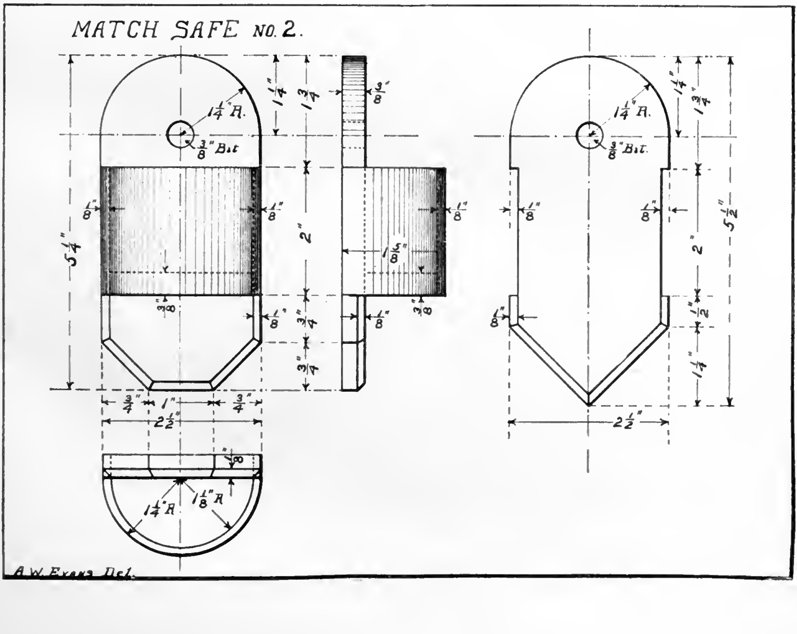
1. Draw center line and lay off curves at each end with pencil and compass.
2. Mark design for chip-carving as shown.
3. Carve handle.
4. Whittle to lines and form the blade with knife.
5. Sandpaper to clean.

No Drawing.

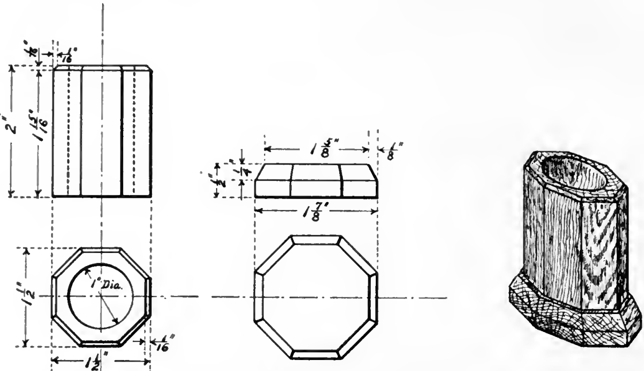

TOOTH BRUSH RACK.
Evans Del
A. R. Kinney Des.


PIN CUSHION AND SCISSORS RACK.
Cork Block Covered with plush
1/4" Whitewood
3/16" Bass.
1/4" Bit.
Evans Del.
H. J. Green Des.


MATCH SAFE No. 1
Evans Del.
Al E. Gage Des.


MATCH SAFE No. 2.
A.W. Evans Del.

MATCH BOX No. 3.

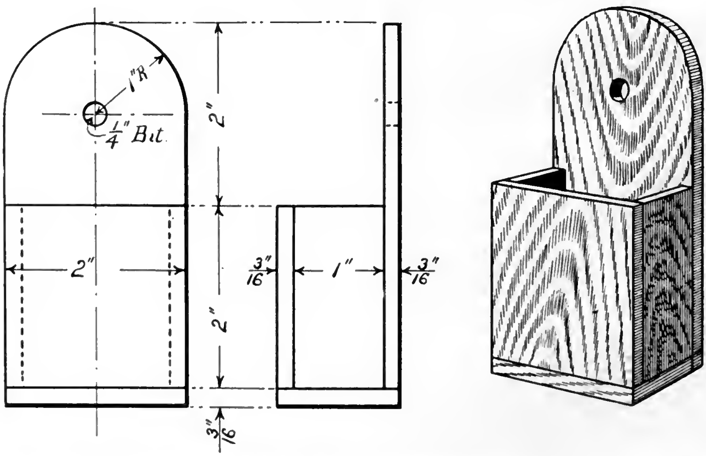


The hole 1" in diameter to be bored through the block while in the rough, block then to be finished using hole as a basis to measure from.

A.W. Evans Del.

Wm. P. Hawley, Designer.

MATCH SAFE No. 4.



MATCH SAFE No. 2.

Stock, 3/8″ Whitewood and 1/8″ Bass.

The directions given for Salt Box No. 1 will apply to this exercise. Decorate by background punching, chip-carving or by inlaying with colored veneer.

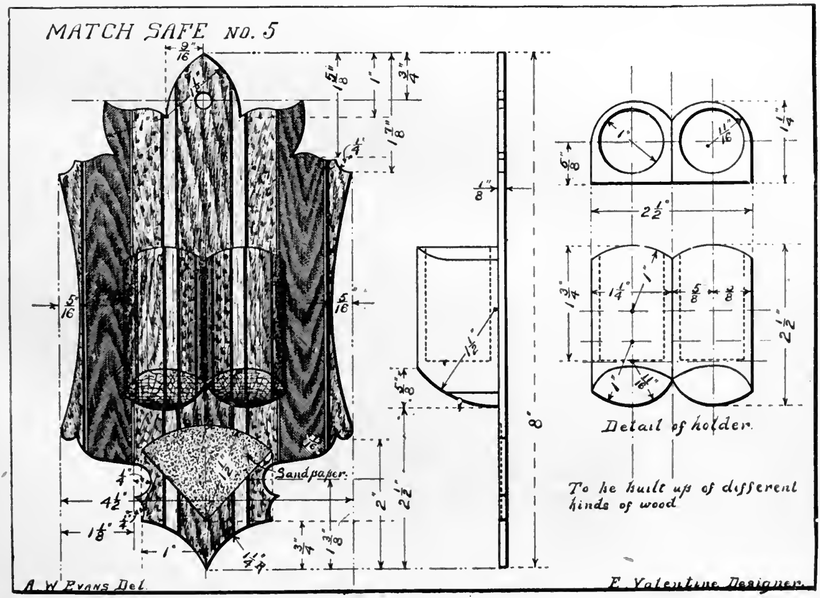
Detail Drawing.

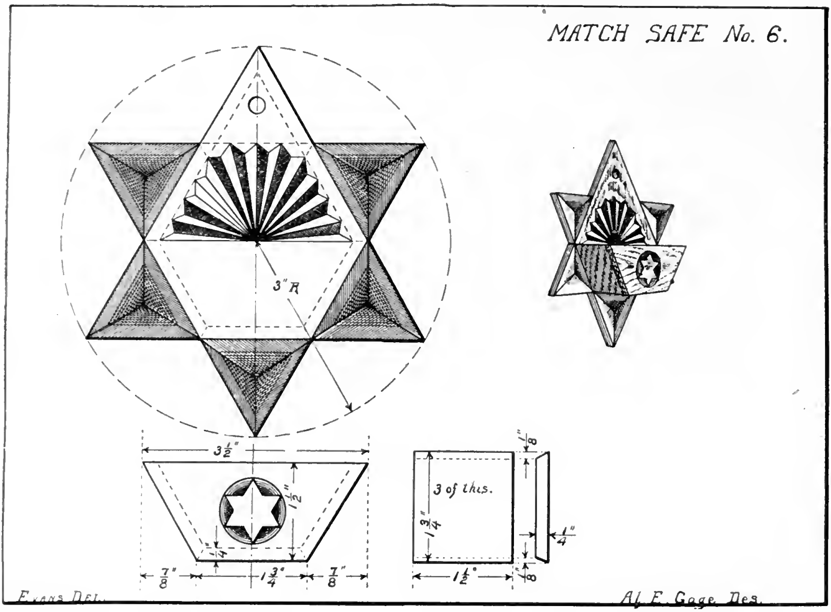
MATCH BOX No. 3.

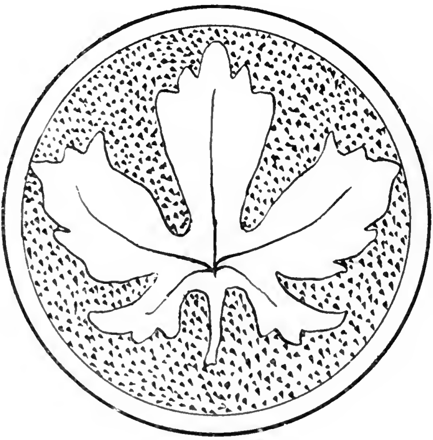
Stock, (several pieces of either hard or soft wood may be used, built up either vertically, horizontally or radially.)

The teacher will give such directions as are necessary to perform the work in accordance with the number and shape of pieces used.

Detail Drawing.



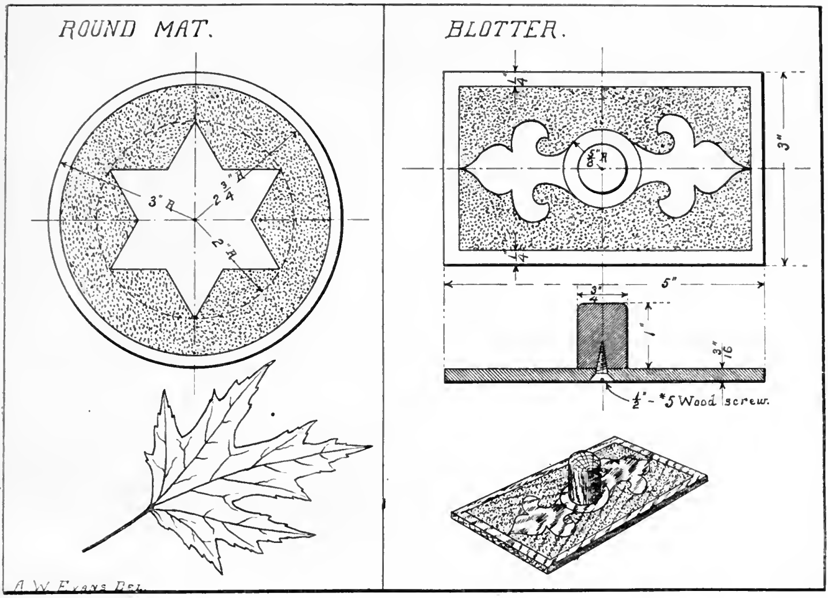




ROUND MAT.

KNIFE.

The most suitable form of knife for cardboard work and for outlining in punching work is shown above. It is called a chip-carving knife and has but one cutting edge, the slanting end.



ROUND MAT.

(An exercise in planing and designing.)

Stock, 1″ x 8″ x 8″ Rough Pine.

1. Plane the piece of rough lumber to the size ½″ x 6″ x 6″, as directed for the *Bracket Shelf* on pages 59 to 61.
2. Find center of board by drawing the diagonals of square.
3. Mark curves with compass and construct design.
4. Saw, with *small turning-saw*, nearly to outer curve and finish with flat file (draw filing.)
5. Suggest that the pupils plan a design to ornament the mat, such as a leaf, a star, or a trefoil. Allow them to make sketches on paper, showing their ideas, before transferring the design to the wood. Cut with the knife a deep line around the inner circle and also around the design, then stamp the background with a carver's punch. The more advanced pupils may profitably vary the shape of the mat, using their own designs. This class of ornamentation, called "diaper carving," is very effective, and

is applicable to almost every kind of woodwork. Carving punches can be made by filing the head of a large nail with a triangular file. (Particular attention should be given to even punching and to correct handling of the hammer.)

6. Clean with No. O sandpaper.

No Drawing.

BLOTTER.

Stock, $\frac{3}{16}''$ x $3\frac{1}{2}''$ x $5\frac{1}{2}''$, s. 2 s., Bass, and $1''$ length of $\frac{3}{4}''$ Dowel-rod.

1. Plane one edge and one end, testing with trysquare.
2. Gauge and plane width.
3. Measure and mark length with *knife* and plane to knife line.
4. Mark border line with gauge and knife.
5. Draw a design with pencil and follow with knife. Punch background. (The ornament is to be original with the pupil.)
6. Round and smooth the end of the handle with knife. Drill and countersink hole, and screw together. (A blotter is to be glued to the base.)

NOTE.—The smoothing plane is to be used in this exercise. Pupils are to be taught to take apart and put together and to whet the plane blades. The grinding will be done by the teacher. The design shown for ornamentation is only suggestive, as are nearly all those shown hereafter. Teachers will vary the designs as seems best, and where possible make use of the ideas of the children. Paper templates may be used for duplication in ornamental designs.

No Drawing.

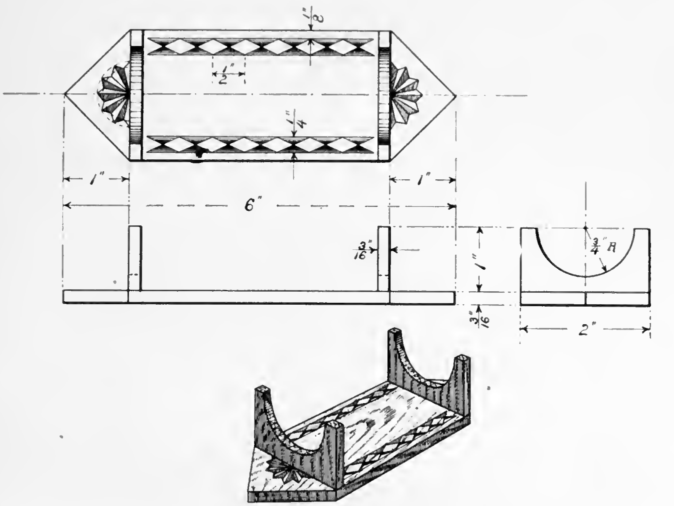
PEN RACK No. 1.

Stock, $\frac{3}{16}''$ x $2\frac{1}{2}''$ x $10''$, s. 2 s., Bass.

1. Plane edges parallel and to required width.
2. Saw off a piece $6\frac{1}{4}''$ long and gauge center line.
3. Point ends with knife; lay off design and carve.
4. Mark a circle on the extra piece and plane ends to proper distance from curve and square with edges.
5. Drill a small hole near edge of the circle, insert blade of coping-saw, and cut to line. Finish with half-round file and saw apart with back-saw.
6. Clean, and fasten together with glue and brads.

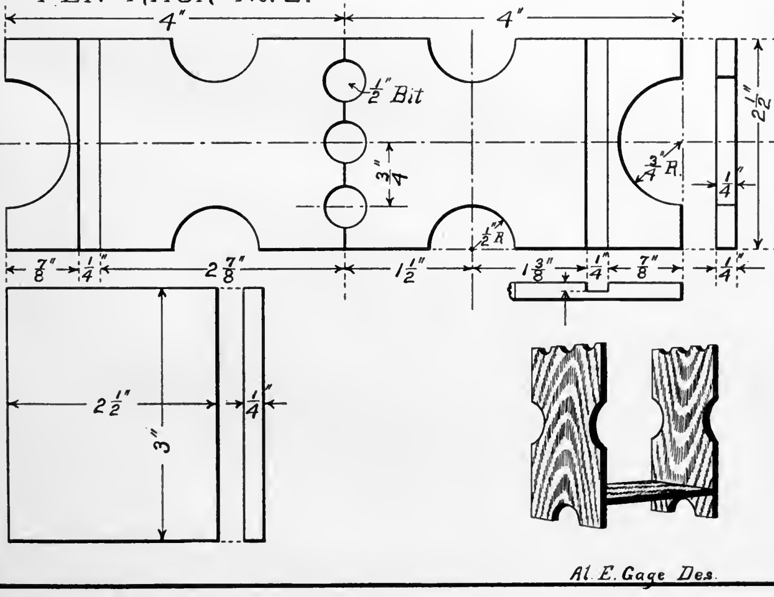
No Drawing.

PEN RACK.

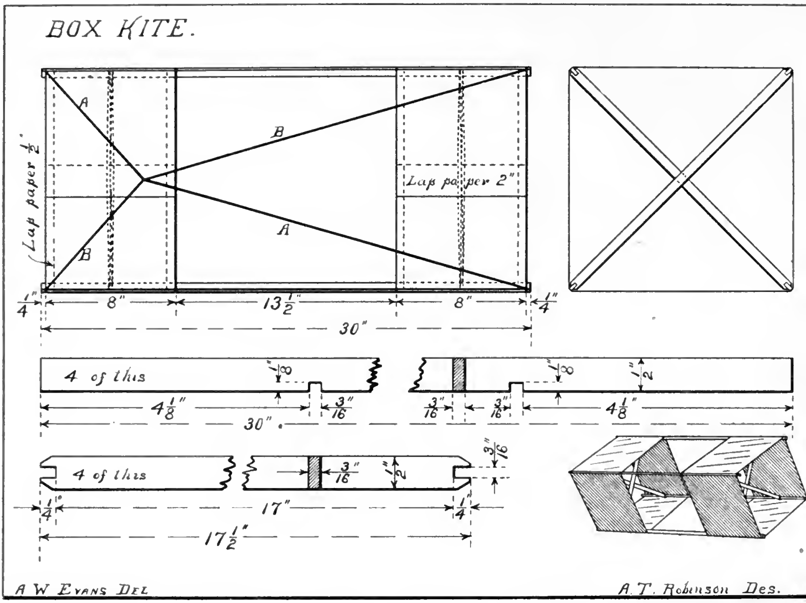


A. W. EVANS DEL.

PEN RACK No. 2.



Al. E. Gage Des.

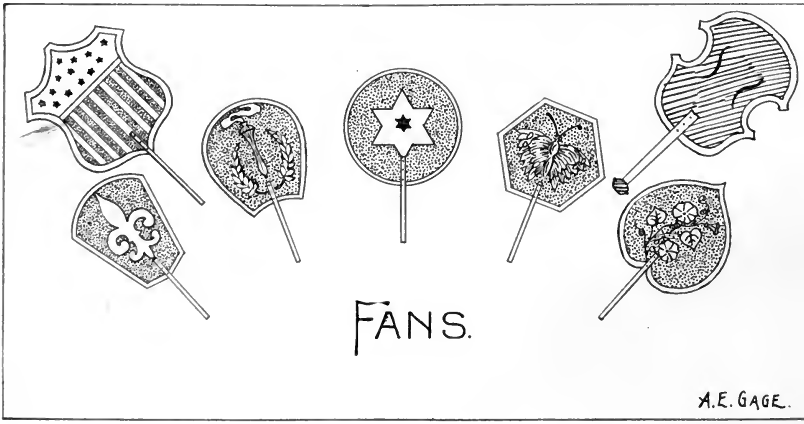


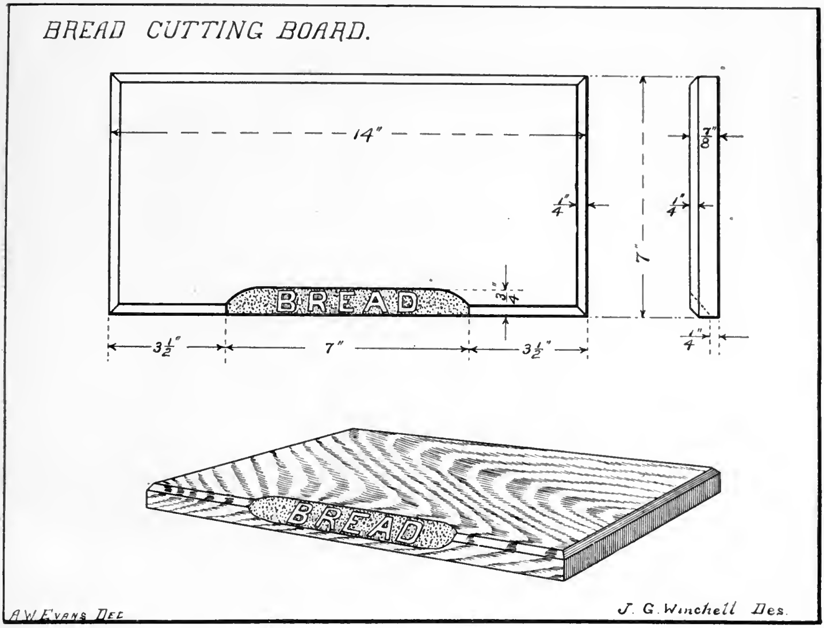
BOX KITE.

Do not fasten the cross sticks of the box kite, but leave them so that by removing them the kite may be rolled into a compact bundle.

Twine for making the kite and bridle, as shown, will be furnished. No twine for flying the kite is to be supplied.

No Drawing.





BREAD CUTTING BOARD.

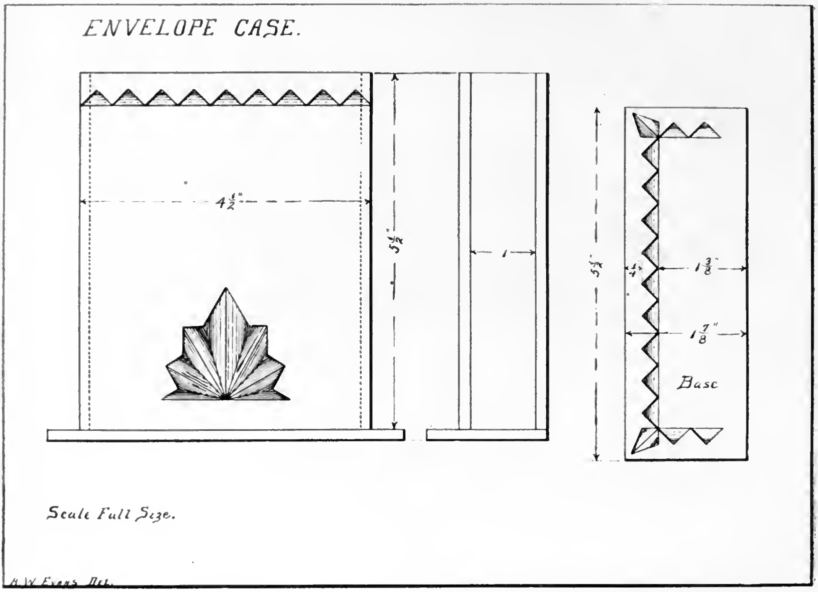
Stock, 1" x 8" x 15", Rough Pine.

For directions see Mat No. 1 on page 23 and Shelf Models on page 59.

No Drawing.

FANS.

These fans are to be made of 1/8" basswood, fastened into handles of oak about 1/2" square. The handles are slotted to receive the fans. This exercise gives opportunity for design in shape and ornamentation which may be carved, stamped or colored.



ENVELOPE CASE.

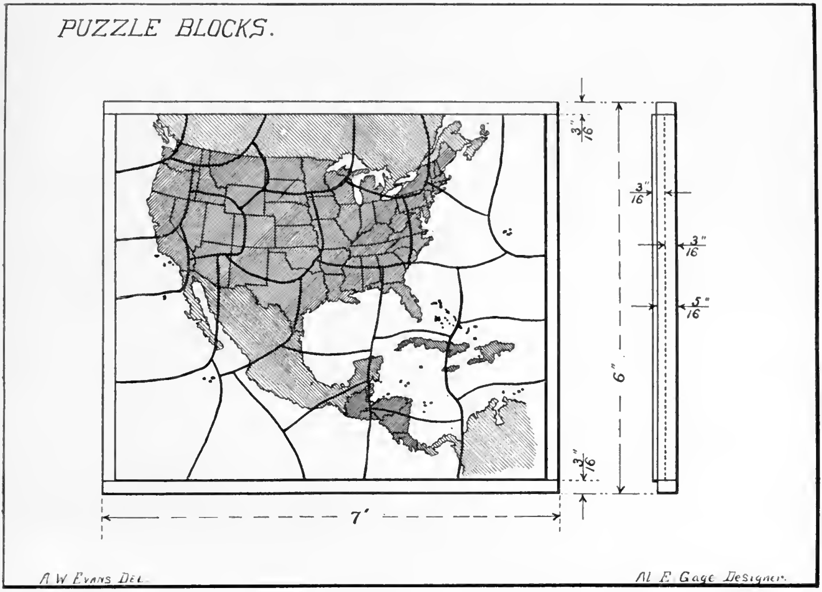
Stock, $\frac{3}{16}''$ Basswood, or $\frac{1}{4}''$ Whitewood.

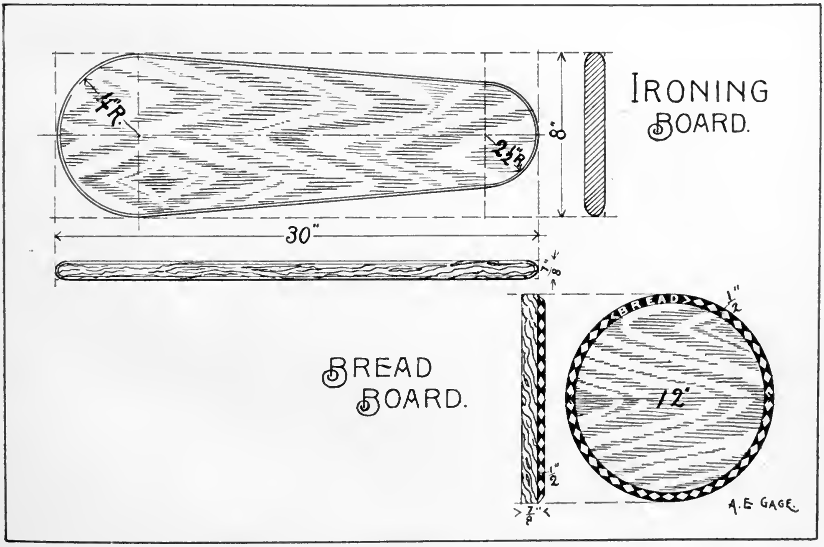
An exercise in the use of the smoothing-plane on edges and ends. Also an exercise in chip-carving.

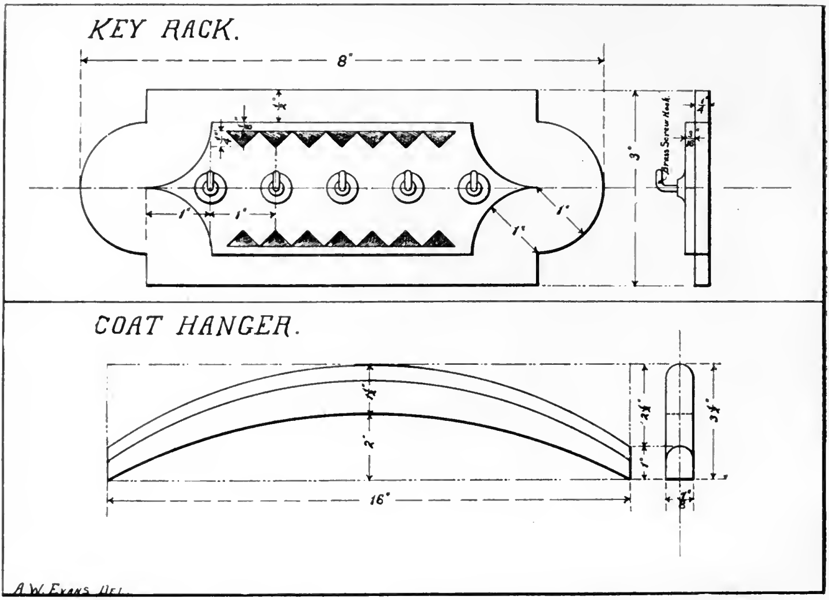
1. Plane pieces to size, using the shooting-board.
2. Carve the base as shown, and ornament the front panel as desired. (An opportunity is here given for very great freedom of expression as the ornamentation may be either chip-carving, diaper carving, low relief, color work or pyrography.)
3. Clean and fasten together with glue and brads, locating the brads by means of a very light gauge line, $\frac{3}{32}''$ from edge, and measuring the distances apart.
4. Finish with sandpaper and shellac.

Drawing as shown.

Note.—Should the Envelope Case be selected as a class exercise the front panel is to be decorated with an original design by the pupil. Any of the methods mentioned in Direction 2 may be used in its execution.


PUZZLE BLOCKS.
3"/16
3"/16
3"/16
5"/16
6"
3"/16
7'
A W Evans Del.
Al E Gage Designer.


IRONING BOARD.
4"R.
2½"R.
8"
30"
7"/8
BREAD BOARD.
BREAD
1"/2
12"
1"/2
7"/8
A.E GAGE.



KEY RACK.

Stock, $\frac{1}{4}''$ x $3\frac{1}{2}''$ x $8\frac{1}{2}''$ Whitewood, and $\frac{3}{16}''$ x $2\frac{1}{2}''$ x $6\frac{1}{2}''$ Cherry.

1. Plane one edge, gauge width and center line (whitewood).
2. Plane to width.
3. Mark curves at ends and square the shoulders with knife lines on both face and edge.
4. Saw curves with turning-saw and saw shoulders with back-saw.
5. Pare vertically with chisel, taking light cuts to lines. Test with try-square.
6. Finish with file, but do not allow a file to be used unless the work has been well done with a sharp chisel.
7. Clean the face with smoothing-plane.
8. Make front plate using turning-saw and file for curves.
9. Carve as shown.
10. Glue in place and locate position of hooks.

11. Clean and finish with shellac.
12. Screw the hooks in place.

NOTE.—Particular care should be used in gluing that the superfluous glue, which is pressed out from between the pieces, is at once removed, and that the clamps are so adjusted as not to mar the work.

No Drawing.

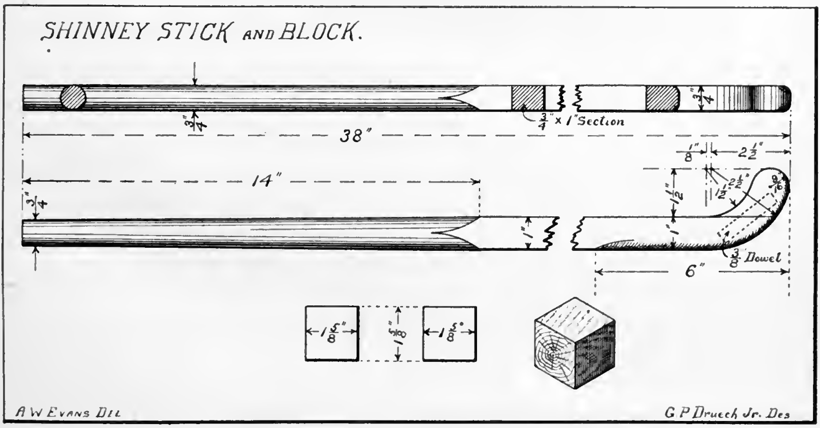
COAT HANGER.

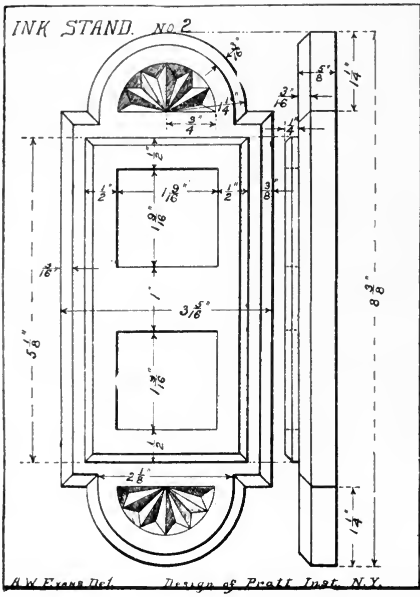
Stock, 1″ x 4″ x 16½″, Rough Pine.

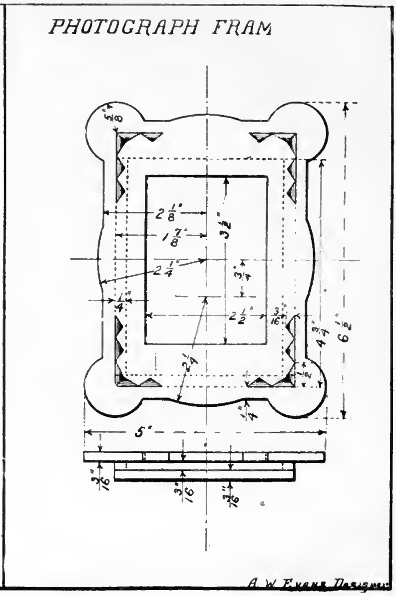
1. Plane all over to ⅞″ x 3½″ x 16″.
2. Mark curves on ends with compass.
3. Mark curves on sides free-hand or with template which may be made of thin basswood.
4. Saw nearly to curves with turning-saw and finish with spokeshave.
5. Finish with sandpaper, but do not use a file.
6. Fit with large screw hook to serve as a hanger.
7. Shellac.

NOTE.—This is principally an exercise in modeling with the spokeshave, therefore all irregularities which can be felt with the hand, are to be removed with that tool. Sandpaper is to be used *only* for cleaning.

No Drawing.







INK STAND No. 2.

Stock, 5/8″ Whitewood or 1/2″ Gum and 1/4″ Maple or 3/16″ Cherry.

An exercise in the use of the chisel and plane and in chip-carving. The thin top piece may be built up from strips of various colors.

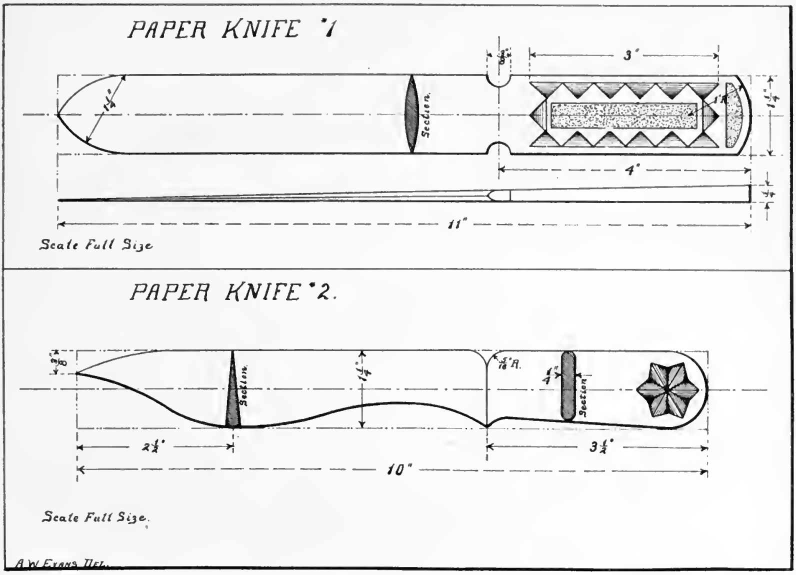
No Drawing.

PHOTOGRAPH FRAME.

Stock, 3/16″ Bass or Cherry.

Use compass, rule, file and knife or coping-saw.

No Drawing.



PAPER KNIFE No. 1.

Stock, 1/4" x 1 3/8" x 11 1/2", s. 2 s., Cherry.

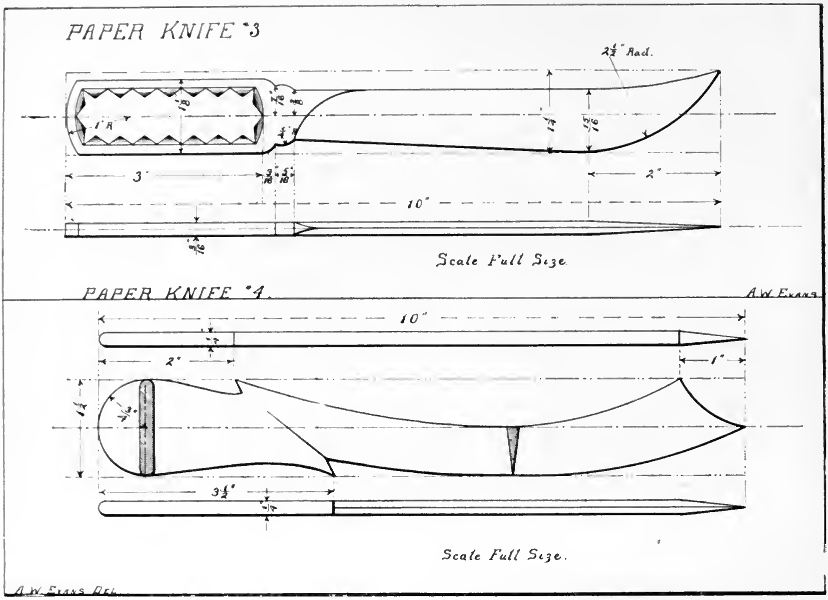
1. Plane to required width.
2. Draw center line lightly with pencil.
3. Lay off curves at ends and at juncture of handle and blade.
4. Cut outline with coping-saw and smooth with file.
5. Form blade with knife, spokeshave and file, working to a center line on the edge.
6. Mark design in handle and carve.
7. Clean thoroughly and finish with three very thin coats of shellac.

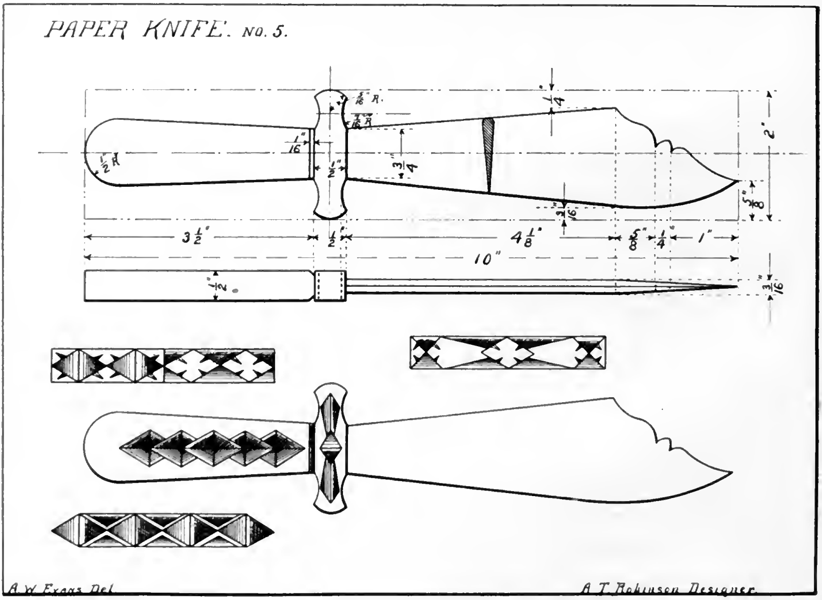
PAPER KNIFE No. 2.

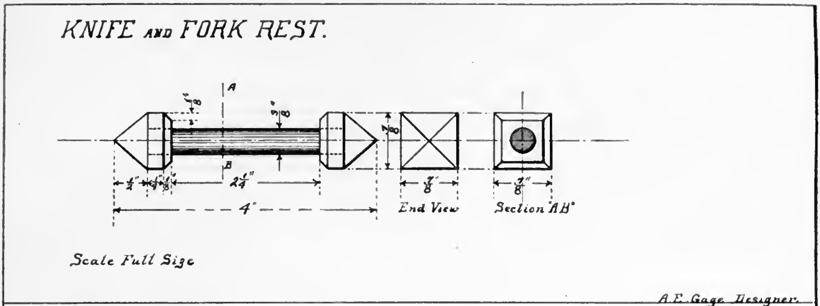
Stock, same as above.

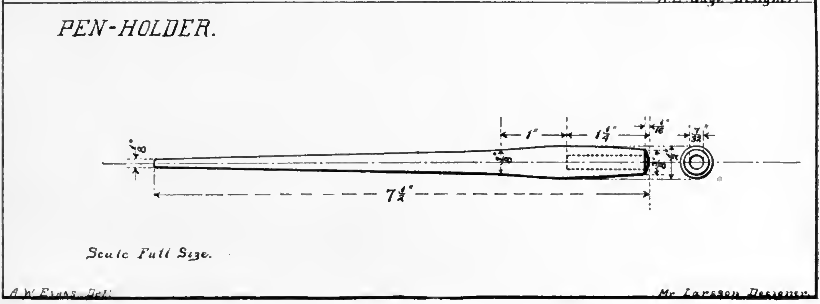
Directions same as for Paper Knife No. 1.

No Drawings.


PAPER KNIFE No. 3
$2\frac{1}{2}$" Rad.
1" R
3"
2"
10"
Scale Full Size
PAPER KNIFE No. 4
A.W. Evans
10"
2"
1"
$3\frac{1}{2}$"
Scale Full Size.
A.W. Evans Del.


PAPER KNIFE. No. 5.
$\frac{5}{16}$" R.
$\frac{3}{16}$" R
$\frac{1}{2}$" R
$3\frac{1}{2}$"
$4\frac{1}{8}$"
1"
10"
2"
A.W. Evans Del.
A.T. Robinson Designer.





KNIFE AND FORK REST.

Stock, ⅞" x 1" x 6½", s. 2 s., Gum.

1. Plane stock to ⅞" x ⅞".
2. Draw diagonals at each end and square around with knife ½" from each end.
3. Square around ¾" from each end and also ⅞" from each end.
4. Saw off just beyond the ⅞" line and block-plane carefully to line, testing with trysquare.
5. Point ends with 1" chisel.
6. Gauge ⅛" from edge on flat end and chisel chamfer.
7. Find center and bore ⅜" holes for cross bar.
8. Plane the remaining piece to a true octagon and after inspection, plane to a ⅜" cylinder.
9. Fit and glue into end pieces.
10. Sandpaper cylindrical part.
11. Finish with shellac.

NOTE.—This exercise may be made from any close grained hard wood. The cross bar may be made from a wood contrasting in color with that of the ends.

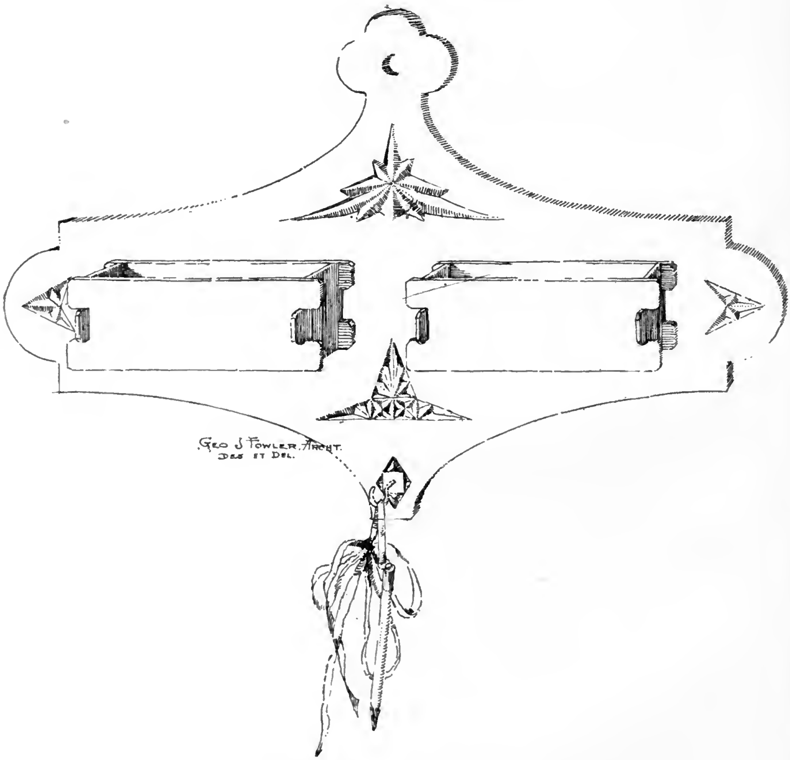
General Drawing without shading.

PEN HOLDER.

Stock, ½″ x ¾″ x 9″, s. 2 s., Red Cedar, or Spanish Cedar.

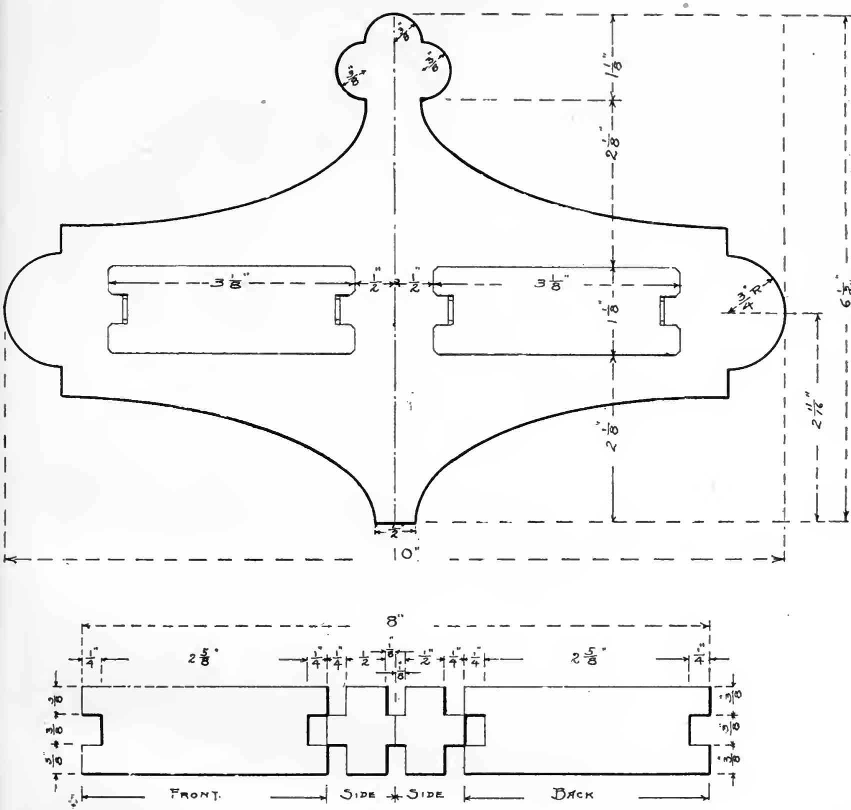
1. Plane stock to ½″ x ½″.
2. Mark circles at ends and bore hole for peg.
3. Cut off 1½″ and form peg to tightly fit hole except at outer end where it should be slightly smaller to admit pen.
4. Glue in peg.
5. Whittle to shape.

No Drawing.



SHOPPING LIST.

Designed to hold cards 1½″ x 2½″, which can be cut from heavy paper or thick folding board, one box to be used for blank



SHOPPING LIST.

cards, the other for shopping memoranda. If made from card-board the boxes could have verses written on:

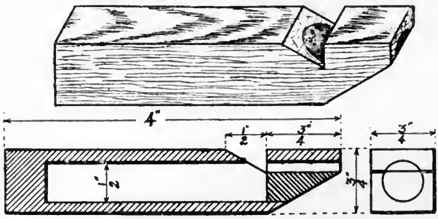
First Box:
Don't forget what you want down town,
But take the pencil and write it down.

Second Box:
Put these cards in any old nook,
Or empty space in your pocket book.

Stock, White Holly, $\frac{1}{8}''$ thick for back, and $\frac{1}{16}''$ thick for boxes.

Make the back as shown, drawing the elliptical curves free hand. Saw with coping-saw and smooth with file; bore ¼″ hole for hanging; carve and fit with small brass screw hook for pencil. Lay off the boxes as shown, measuring for tenons at each end and drawing one line of all the tenons without removing rule. Cut pieces apart and form tenons on each piece with chisel. Make and fit bottoms to go inside of boxes. Clean all pieces with No. OO sandpaper, glue boxes together and fasten with glue to back.

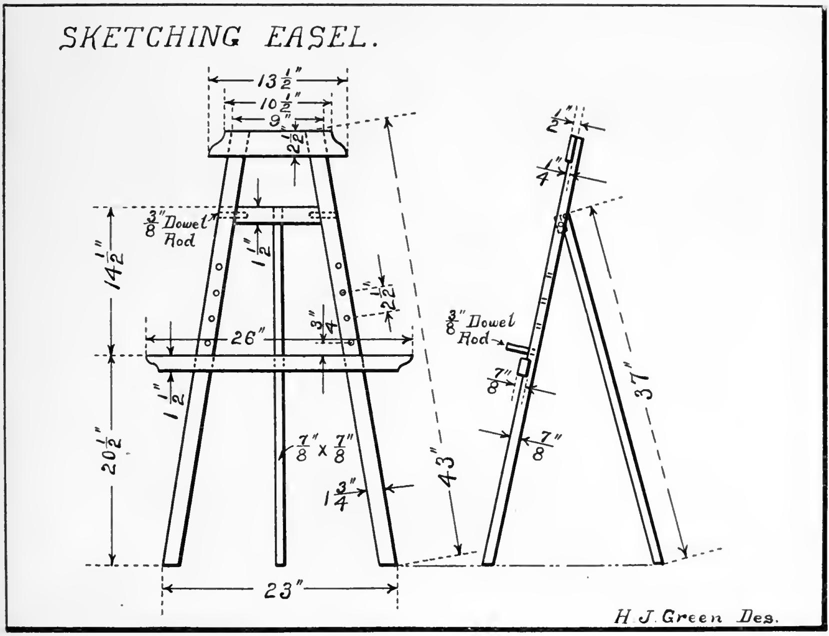
A WHISTLE.

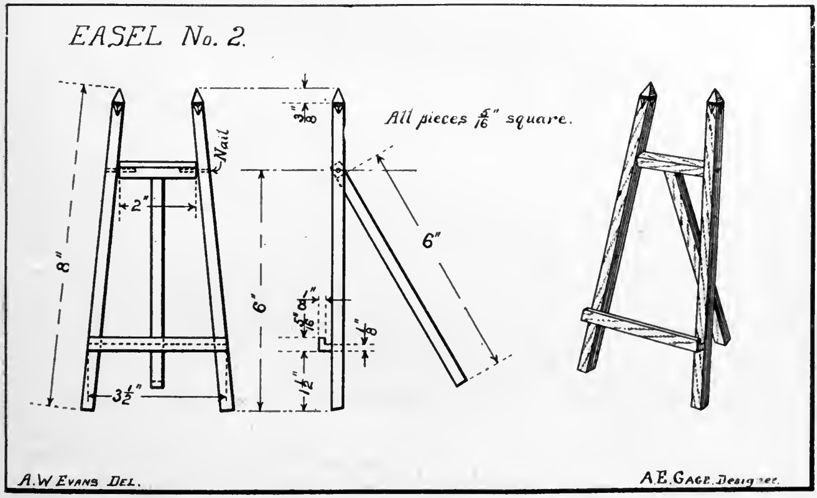


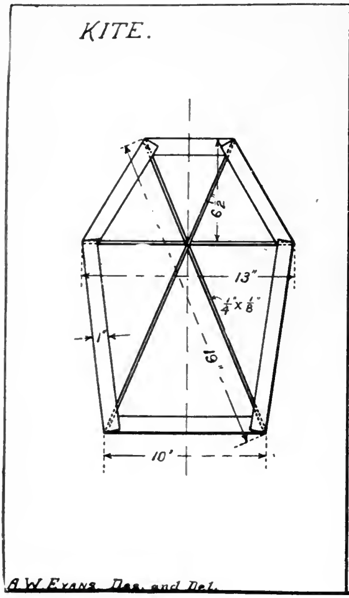
Design of A.E.Gage.

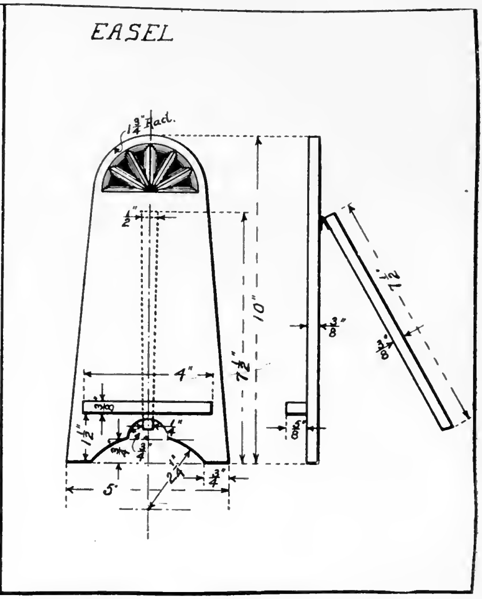
Stock, Pine, ⅞″ x ⅞″ x 4½″, s. 2 s., and a short length of ½″ dowel rod.

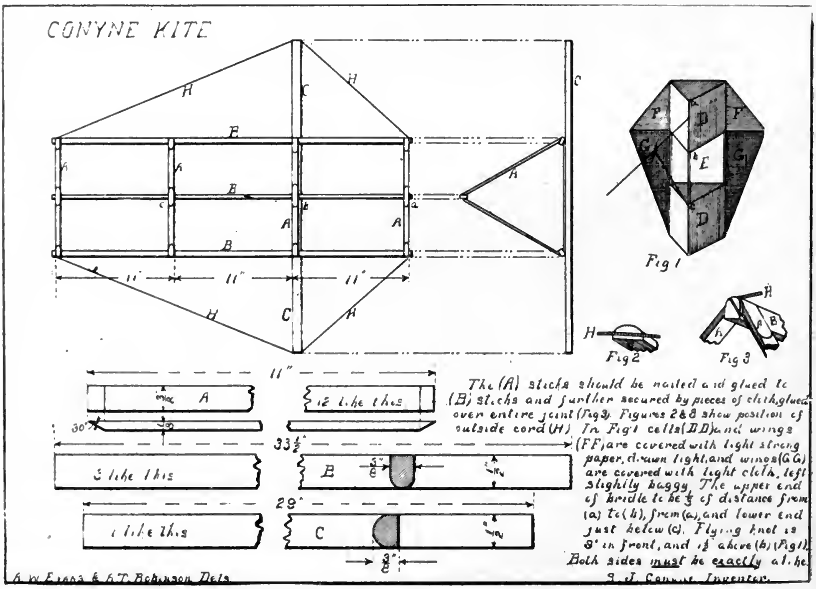
Plane the stick to ¾″ square. Whittle to the length shown in the drawing. Bore the ½″ hole about 3½″ deep. Cut off a piece of the dowel rod 1¼″ long. Plane a flat side on this plug and glue it into the hole you have bored. When the glue is dry whittle the notch and the bevel.


SKETCHING EASEL.
13 1/2"
10 1/2"
9"
2 1/2"
3/8" Dowel Rod
14 1/2"
1 1/2"
26"
3/4"
2 1/2"
20 1/2"
7/8" x 7/8"
1 3/4"
43"
23"
1/2"
1/4"
3/8" Dowel Rod
7/8"
7/8"
37"
H. J. Green Des.

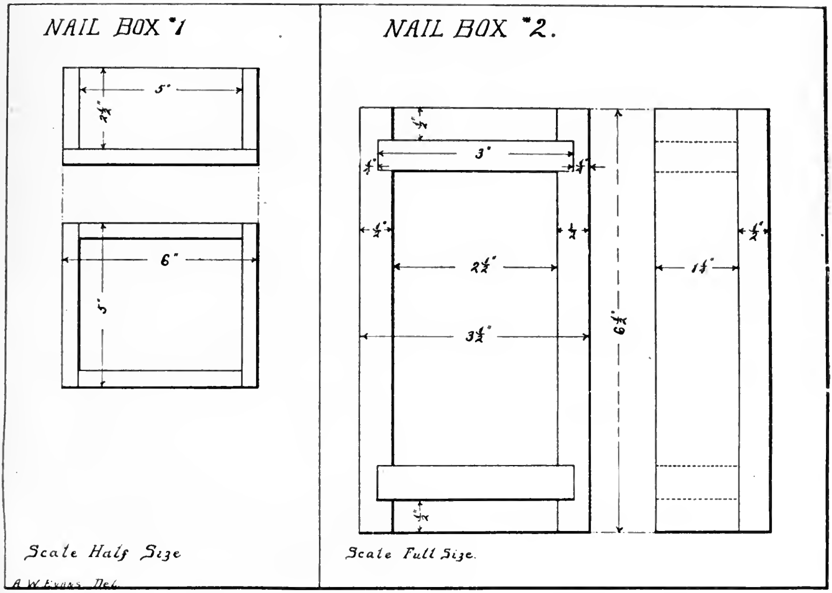

EASEL No. 2.
All pieces 5/16" square.
8"
Nail
2"
3 1/2"
3/8"
6"
6"
5/16"
1/8"
1/8"
1 1/2"
A. W. Evans Del.
A. E. Gage. Designer.







To make a kite which will fold flat use string in place of sticks A.



NAIL BOX No. 1.

Stock, ½", s. 2 s., Pine.

1. Plane one piece to the required width for the four sides.
2. Plane one end on shooting-board.
3. Measure length for one side piece and square all around with knife.
4. Saw off with back-saw and plane the end to knife-lines on shooting-board.
5. Proceed as above for each side.
6. Measure and mark for brads as directed in Envelope Case.
7. Nail and glue together.
8. Plane and fit bottom.
9. Clean all over and shellac.

NOTE.—Teach use of nail-set.

Have inner surface cleaned before fitting together.

General Drawing as shown.

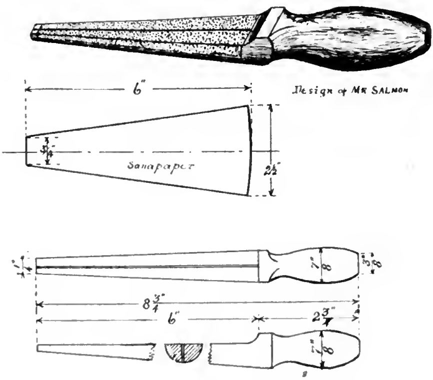
NAIL BOX No. 2.

Stock, ½", s. 2 s., Pine.

1. Plane sides and ends to size, as for Nail Box No. 1.
2. Mark out gains with knife lines and gauge.
3. Saw with back-saw exactly to knife lines so that no chiseling will be required on sides of gains.
4. Chisel gains with ⅜" chisel.
5. Fit and glue together, after cleaning inner surfaces.
6. Prepare bottom and nail and glue to frame.
7. Clean with the smoothing-plane and sandpaper.
8. Shellac.

General Drawing as shown.

A SANDPAPER FILE.

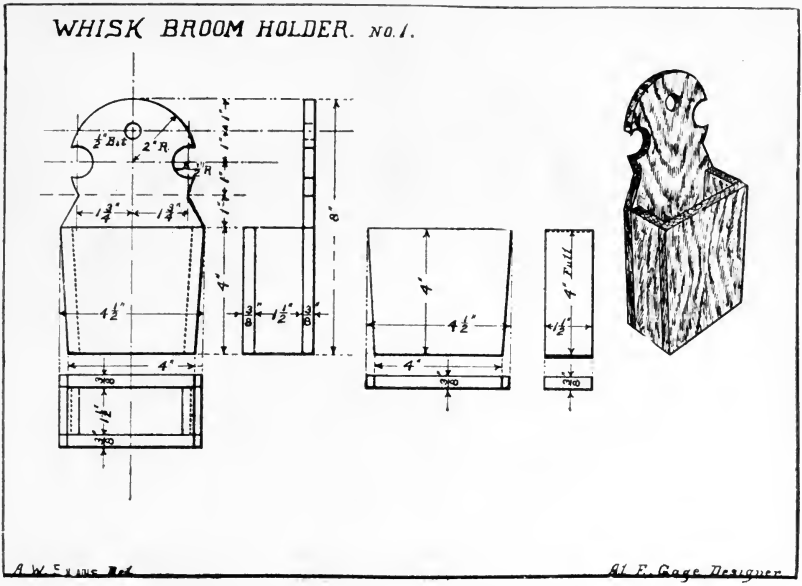


Stock, a pine stick 10" long by 1" square.

Whittle the stick to the shape shown in the drawing. Split the blade as shown, using the rip-saw.

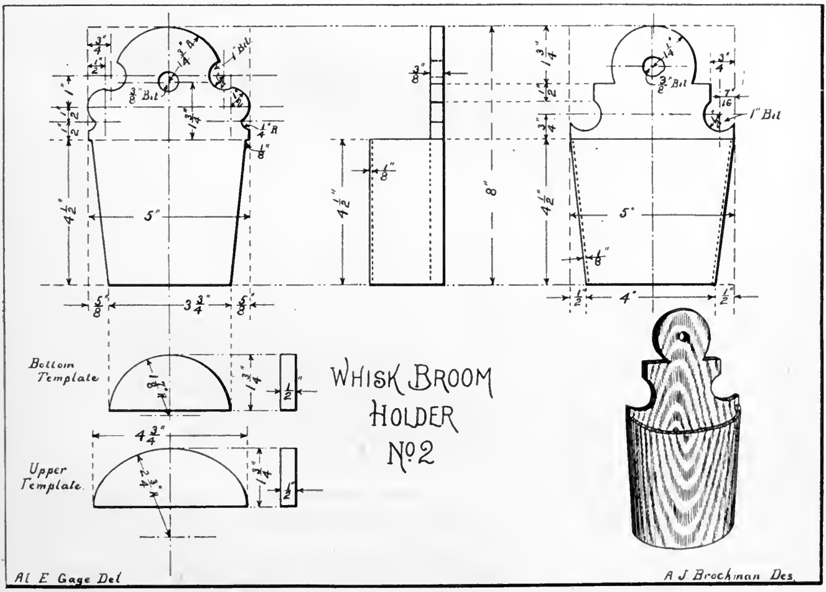
Now cut a piece of sandpaper to the size and shape shown, and fold it around the file so that the edges are locked in the saw-kerf.

This exercise produces a most useful tool for finishing hollows and rounds.



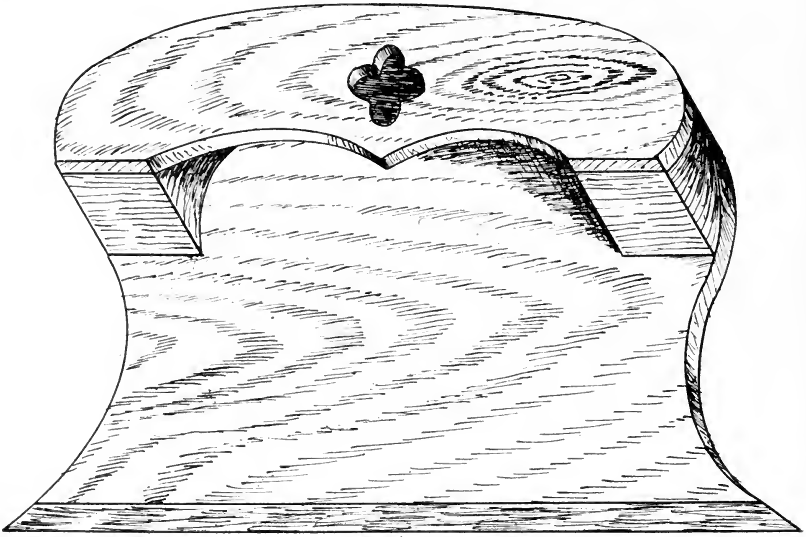
WHISK BROOM HOLDER No. 1.

Stock, 3/8″, Whitewood.
General directions for planing dressed lumber.
General Drawing.

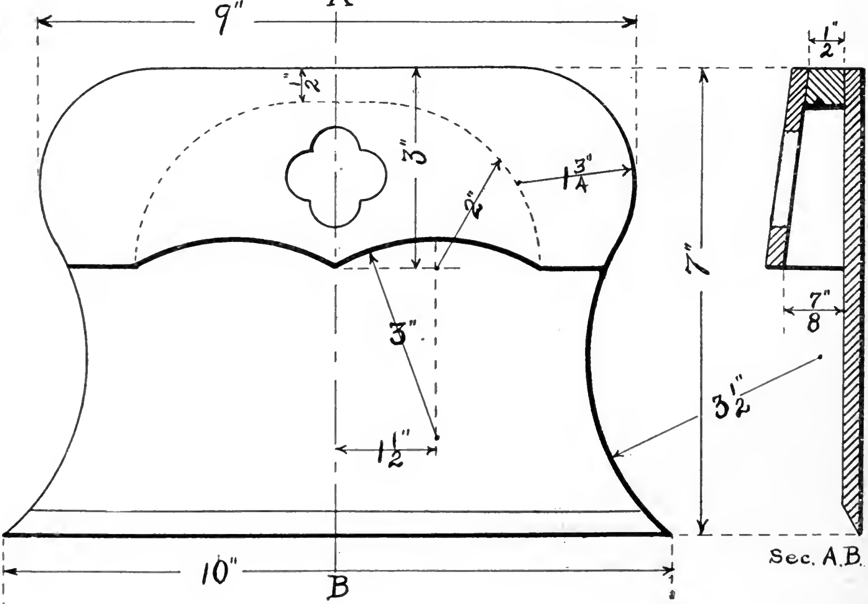


See directions for Salt Box No. 1.

CRUMB TRAY.



DESIGN OF A. J. BROCKMAN.

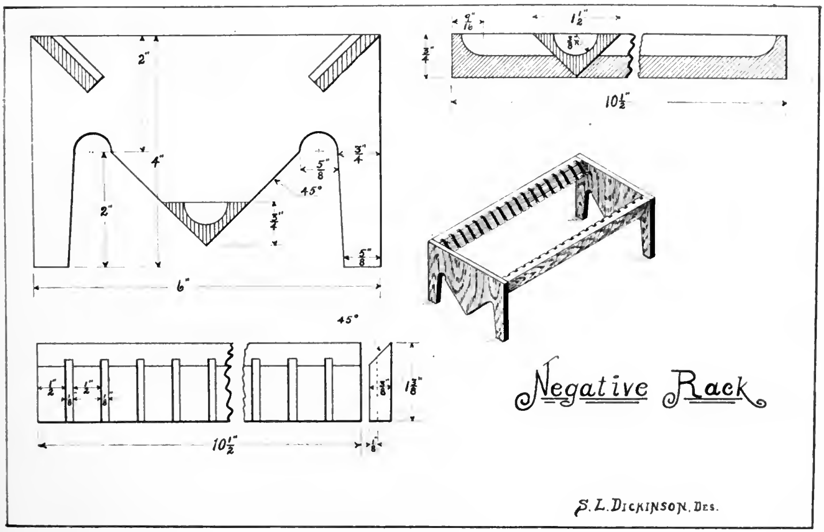


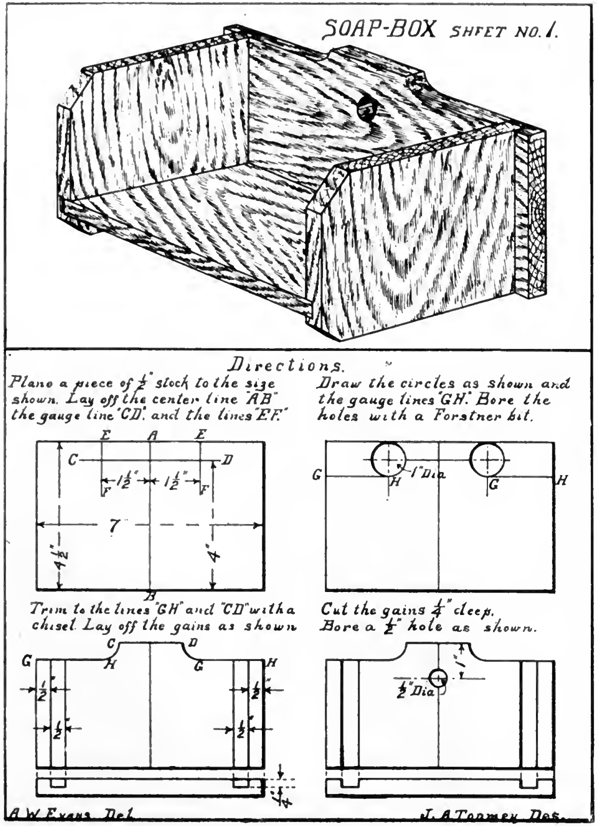
CRUMB TRAY.

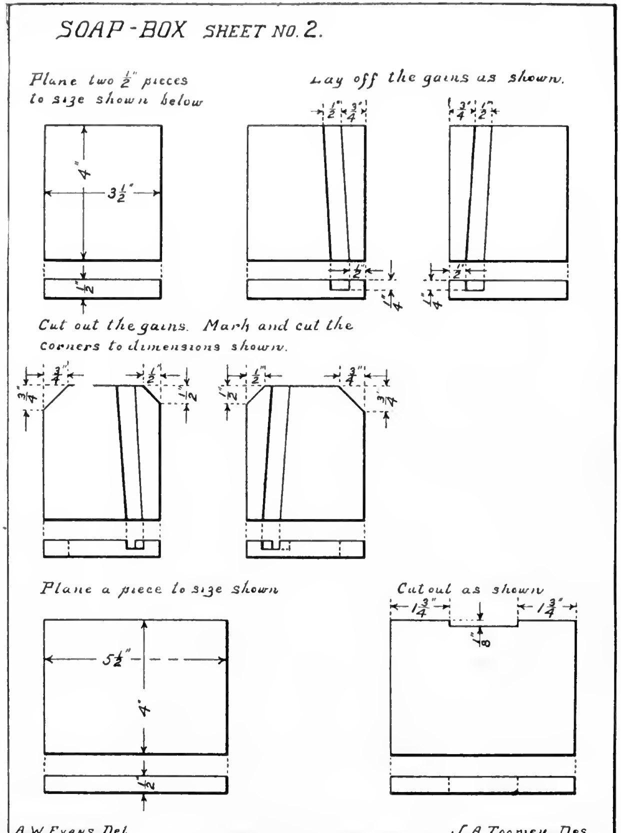
Stock, light colored Hard Wood for base and top, gum or other dark wood for back.

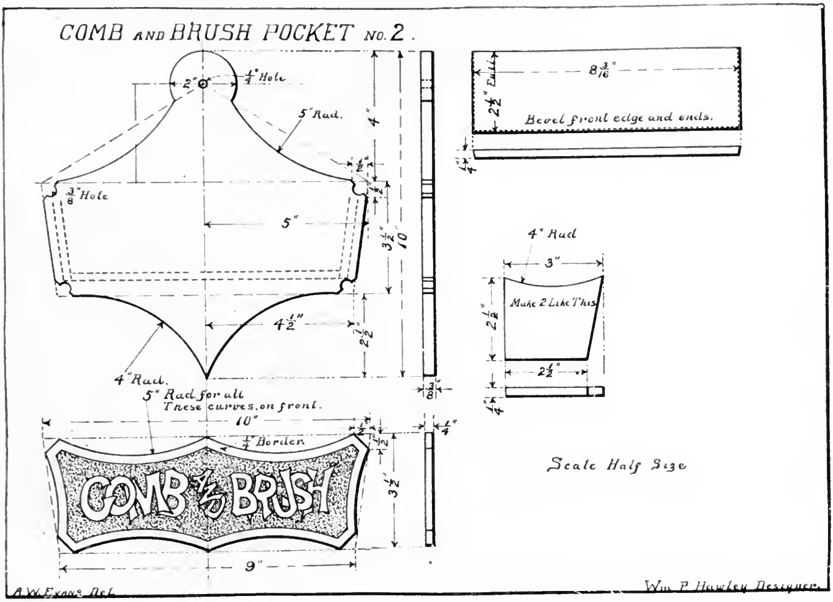
Mark and cut out the bottom and top pieces as shown in the working drawing, using the coping-saw and file. Plane the back piece to the required bevel and mark and cut the concave curve. Then fasten the three pieces together with glue and brads. Saw the back to the same shape as the base piece and finish with file and sandpaper. The base and top may be ornamented with diaper or chip-carving. A chip-carving border may be worked around the back piece. Finish with shellac.

No Drawing.




SOAP-BOX SHEET NO. 1.
Directions.
Plane a piece of 1/2" stock to the size shown. Lay off the center line "AB" the gauge line "CD" and the lines "EF"
Draw the circles as shown and the gauge lines "GH". Bore the holes with a Forstner bit.
7"
4 1/2"
4"
1 1/2"
1" Dia
Trim to the lines "GH" and "CD" with a chisel. Lay off the gains as shown
Cut the gains 1/4" deep. Bore a 1/2" hole as shown.
1/2" Dia
A.W. Evans Del.
J. A. Toomey Des.


SOAP-BOX SHEET NO. 2.
Plane two 1/2" pieces to size shown below
Lay off the gains as shown.
4"
3 1/2"
Cut out the gains. Mark and cut the corners to dimensions shown.
Plane a piece to size shown
5 1/2"
4"
Cut out as shown
1 3/4"
1/8"
A.W. Evans Del.
J. A. Toomey Des.



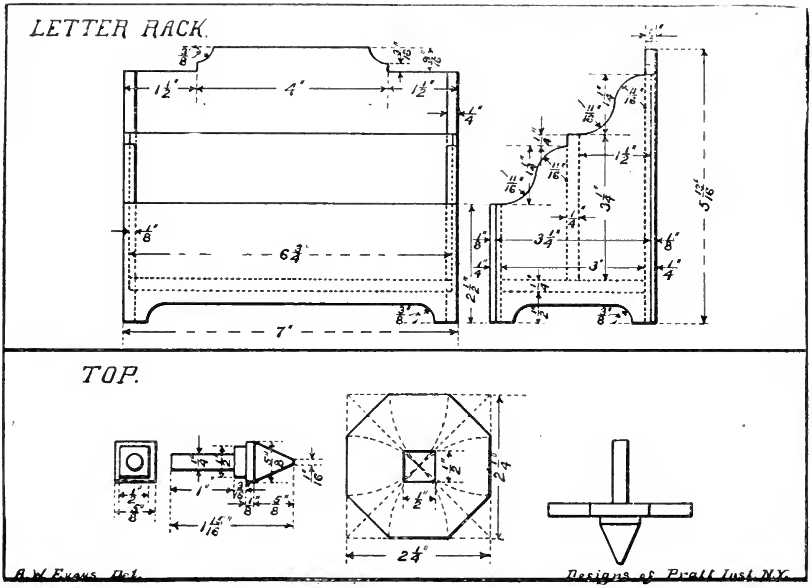
COMB AND BRUSH POCKET No. 2.

Stock, ⅜" and ¼" Whitewood.

An exercise in the use of the spokeshave and bevel, also ornamentation by means of letters.

1. Make back piece first, then front and sides.
2. Set bevel to angle of side pieces and use in planing the bevel edge of the bottom piece.
3. Fasten together with glue and brads.
4. Shellac, 2 coats.

Detail Drawing.



LETTER RACK.

Stock, $\frac{1}{4}''$ Hardwood.

Construct rack according to drawing and either carve or punch a design on sides and front.

This model should be highly polished.

No Drawing.

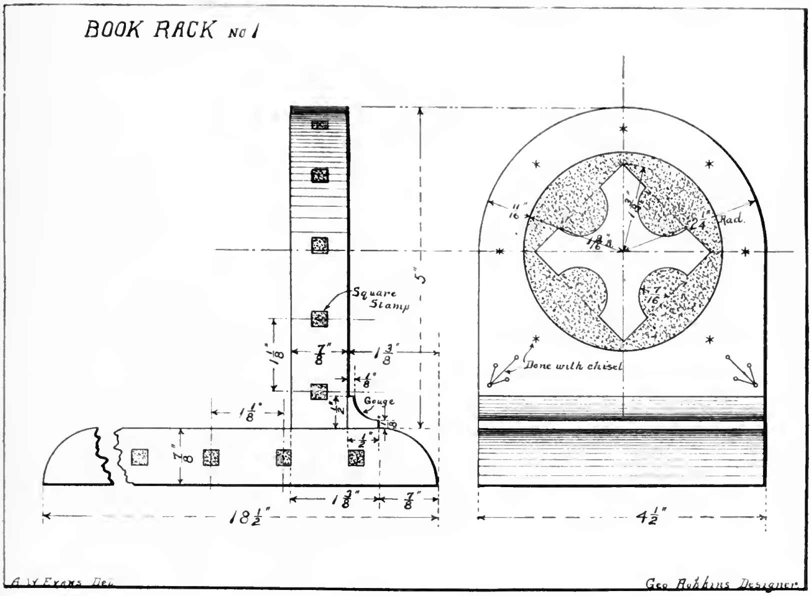
TOP.

Stock, $\frac{3}{16}''$ Basswood.

Stock, $\frac{5}{8}''$ Hardwood.

Make this entirely an exercise in chiseling.

No Drawing.



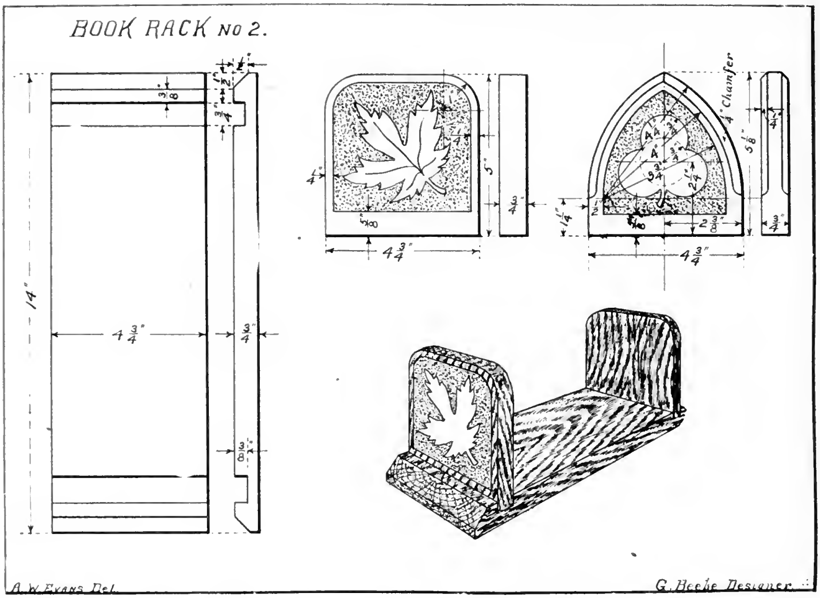
BOOK RACK No. 1.

Stock, ⅞″ x 5½″ x 30″, s. 2 s., Pine.

1. Plane to width, saving the long strip from edge for making the moulding.
2. Plane ends square.
3. Gauge center line and measure 2¾″ from ends which will give center for curves.
4. Mark curves and saw off.
5. Finish curves with chisel and file. (See Note.)
6. Mark design as shown and cut the outline with knife.
7. Shellac and then stamp background and cut stars with ⅛″ chisel.
8. Make base by planing the curved ends.
9. Stamp edges.
10. Make moulding; glue and nail together and finish with shellac.

NOTE.—The filing should be done in the direction of the curve and not at right angles to the face of board.

Drawing as shown, omitting shading.

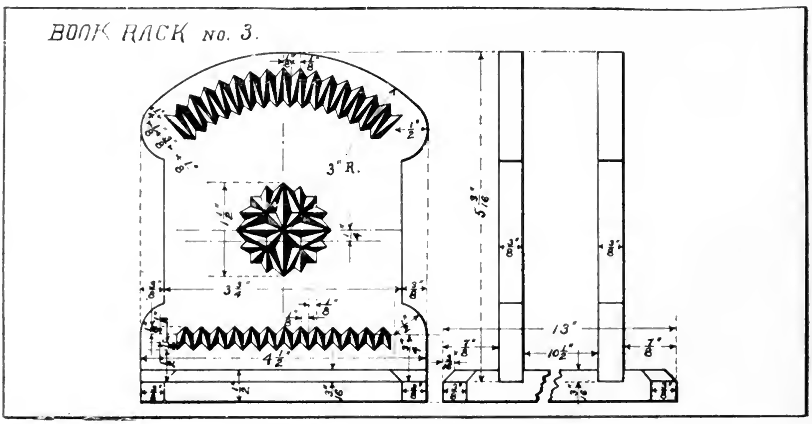


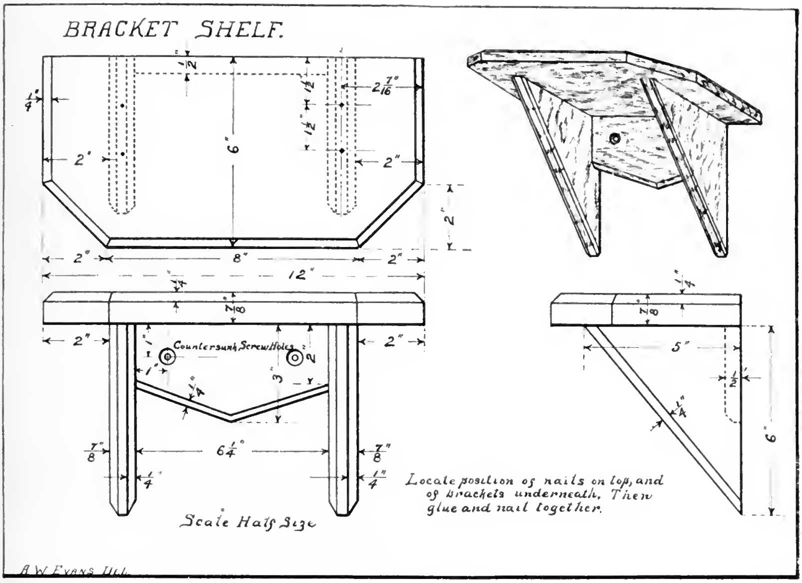
BOOK RACK No. 2.

Stock, Oak or other Hardwood.

The directions for this are practically the same as for Book Rack No. 1.

Drawing as shown.





BRACKET SHELF.

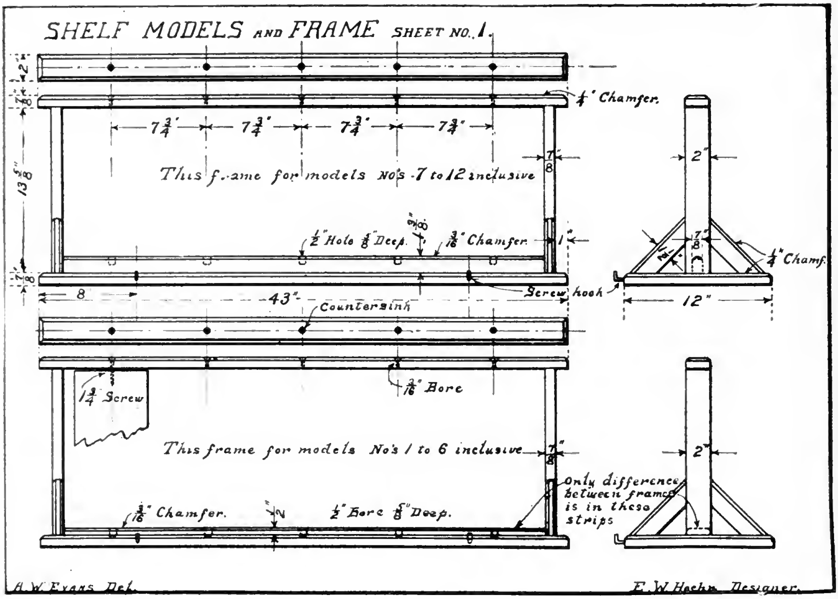
Stock, 1″ x 7″ x 20″ rough Pine, and ½″ x 3½″ x 6½″, s. 2 s., Pine.

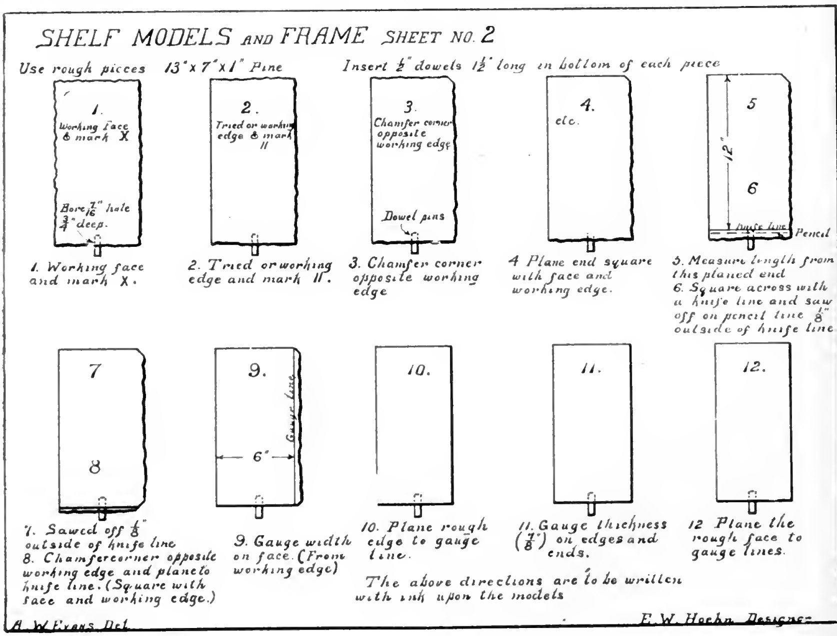
First have pupils saw off a piece 7″ long, then plane and finish the top of shelf according to directions. A set of models, such as are shown on the following page, are a great help in directing this work if it is used as a first planing exercise or if given as an extra. This method of showing processes is not to be carried beyond the first year's work. The shelf may be made with the chamfered edge of the top underneath instead of as in the drawing.

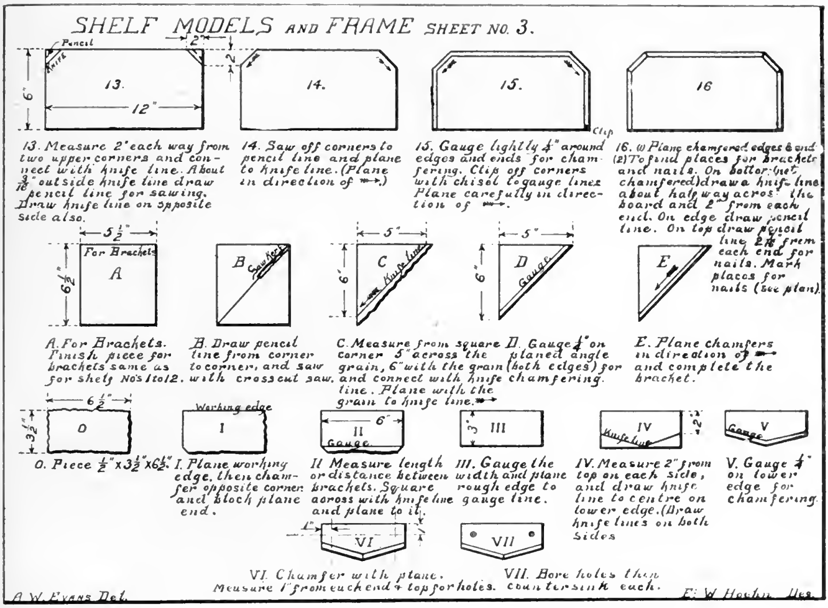
A blue print of the following directions may be placed before the pupil.

1. Plane the working *face* and mark it X.
2. Plane the working *edge* and mark it II.
3. Chamfer a *corner* [ask teacher which one.]
4. Plane this *end* square with working *face* and working *edge*.
5. Measure the length from this planed *end*.
6. Square across with knife-line.
7. Saw off *end* just beyond the knife-line.
8. Chamfer a corner opposite tried *edge* and plane this *end* to knife-line.
9. Gauge the *width*.
10. Plane the *rough edge* to gauge-line.
11. Gauge the *thickness* on edges and ends.
12. Plane the *rough face* to gauge-lines.

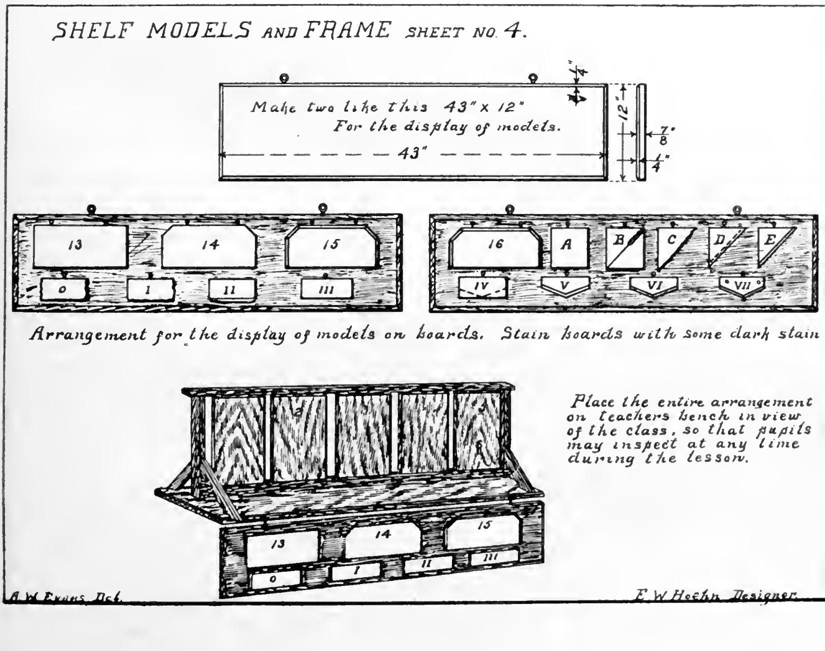
General Drawing.


SHELF MODELS AND FRAME SHEET NO. 1.
¼" Chamfer.
7¾"
This frame for models No's 7 to 12 inclusive
½" Hole ⅜" Deep.
3/16" Chamfer.
Screw hook
43"
8
12"
Countersink
¼" Chamf.
1¾ Screw
3/16" Bore
This frame for models No's 1 to 6 inclusive
Only difference between frames is in these strips
3/16" Chamfer.
½" Bore ⅝" Deep.
A. W. Evans Del.
E. W. Hoehn Designer.


SHELF MODELS AND FRAME SHEET NO. 2
Use rough pieces 13" x 7" x 1" Pine
Insert ½" dowels 1½" long in bottom of each piece
Working face & mark X
Bore 7/16" hole ¾" deep.
Tried or working edge & mark II
Chamfer corner opposite working edge
Dowel pins
etc.
Knife line
Pencil
1. Working face and mark X.
2. Tried or working edge and mark II.
3. Chamfer corner opposite working edge
4 Plane end square with face and working edge.
5. Measure length from this planed end
6. Square across with a knife line and saw off on pencil line ⅛" outside of knife line
Gauge line
6"
7. Sawed off ⅛" outside of knife line
8. Chamfer corner opposite working edge and plane to knife line. (Square with face and working edge.)
9. Gauge width on face. (From working edge)
10. Plane rough edge to gauge line.
11. Gauge thickness (⅞") on edges and ends.
12 Plane the rough face to gauge lines.
The above directions are to be written with ink upon the models
A. W. Evans Del.
E. W. Hoehn Designer

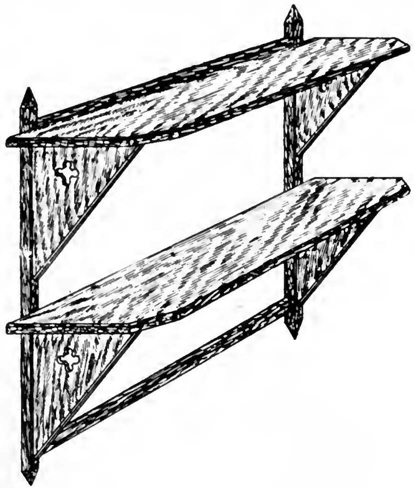


SHELF MODELS AND FRAME SHEET NO. 3.
Pencil
Knife
2"
2"
6"
12"
13.
14.
15.
16
Clip
13. Measure 2" each way from two upper corners and connect with knife line. About 3/16" outside knife line draw pencil line for sawing. Draw knife line on opposite side also.
14. Saw off corners to pencil line and plane to knife line. (Plane in direction of →.)
15. Gauge lightly 1/4" around edges and ends for chamfering. Clip off corners with chisel to gauge lines. Plane carefully in direction of →.
16. (1) Plane chamfered edges & ends. (2) To find places for brackets and nails. On bottom (not chamfered) draw a knife line about halfway across the board and 2" from each end. On edge draw pencil line. On top draw pencil line 2 1/8" from each end for nails. Mark places for nails (see plan).
5 1/2"
6 1/2"
For Brackets
A
B
Saw Kerf
5"
6"
C
Knife line
D
Gauge
E
A. For Brackets. Finish piece for brackets same as for shelf No's 1 to 12.
B. Draw pencil line from corner to corner, and saw with crosscut saw.
C. Measure from square corner 5" across the grain, 6" with the grain and connect with knife line. Plane with the grain to knife line. →
D. Gauge 1/4" on planed angle (both edges) for chamfering.
E. Plane chamfers in direction of → and complete the bracket.
6 1/2"
3 1/2"
O
Working edge
I
6"
II
Gauge
3"
III
IV
Knife line
2"
V
Gauge
O. Piece 1/2" x 3 1/2" x 6 1/2".
I. Plane working edge, then chamfer opposite corner and block plane end.
II Measure length or distance between brackets. Square across with knife line and plane to it.
III. Gauge the width and plane rough edge to gauge line.
IV. Measure 2" from top on each side, and draw knife line to centre on lower edge. (Draw knife lines on both sides
V. Gauge 1/4" on lower edge for chamfering.
1"
VI
VII
VI. Chamfer with plane. Measure 1" from each end + top for holes.
VII. Bore holes then countersink each.
A. W. Evans Del.
E. W. Hoehn Des.



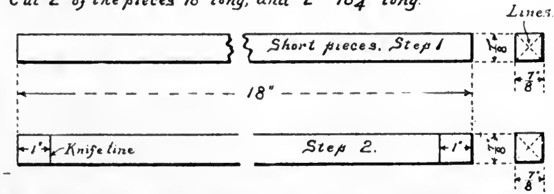
SHELF MODELS AND FRAME SHEET NO. 4.
1/4"
Make two like this 43" x 12"
For the display of models.
43"
12"
7/8"
1/4"
13
14
15
O
I
II
III
16
A
B
C
D
E
IV
V
VI
VII
Arrangement for the display of models on boards. Stain boards with some dark stain
Place the entire arrangement on teachers bench in view of the class, so that pupils may inspect at any time during the lesson.
13
14
15
O
I
II
III
A. W. Evans Del.
E. W. Hoehn Designer.

HANGING SHELVES SHEET NO. 1.



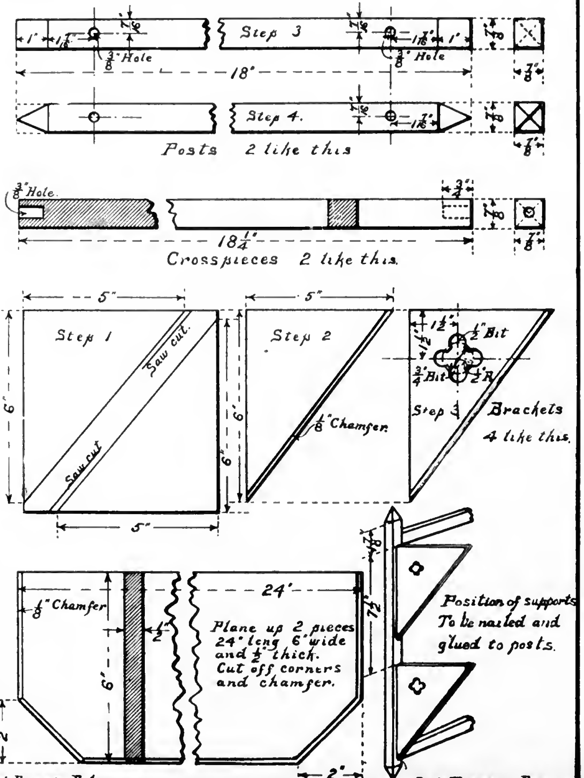
Directions.

Plane up 4 pieces $\frac{7}{8}$" Square and 20" long.
Cut 2 of the pieces 18" long, and 2 - $18\frac{1}{4}$" long.

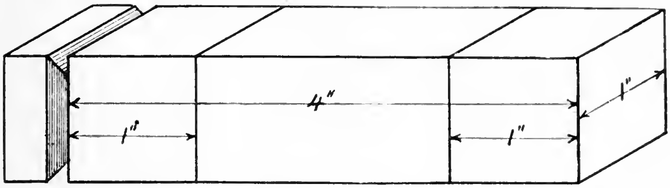


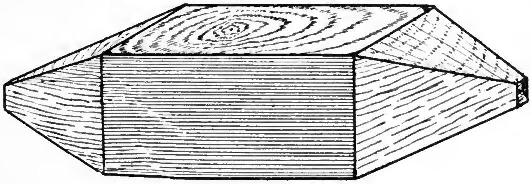
A. W. Evans Del. J. A. Toomey Designer.

HANGING SHELVES. SHEET NO 2.



A. W. Evans Del. J. A. Toomey Des.





THE CAT.

Tipcat is a game known and enjoyed by nearly all city boys. The implements for playing are usually made by the boys themselves, and make very appropriate whittling exercises.

THE CAT.

Stock, 1¼" x 1¼" Gumwood.

A whittling exercise.

1. Plane to 1" square by 4½" long.
2. Square around and true the ends with the knife as shown.

Insist that both ends be alike and accurately made. This being a toy for the boys games, he is likely to hurry and slight his work ; the tendency is to be restrained.

No Drawing.

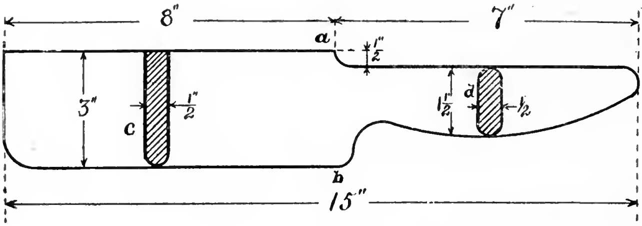
THE BAT.

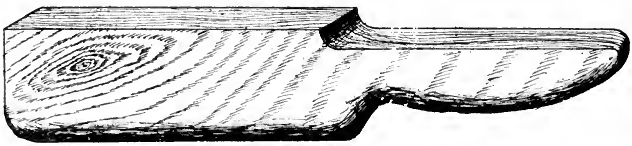
Stock, ½" Pine or Maple.

If made of pine, only the knife, rule and pencil are required. Maple would require the use of the spokeshave and turning-saw.

Let the pupils sketch the outline on the side of the board, locating the points "a" and "b" by measurement. The curves should be sketched free-hand. Whittle out the shape, as shown in the mechanical drawing, before attempting to round the under side. (Note the method used to show all details of the shape of this object in one drawing by means of sections "c" and "d").

No Drawing.





TIPCAT BAT.

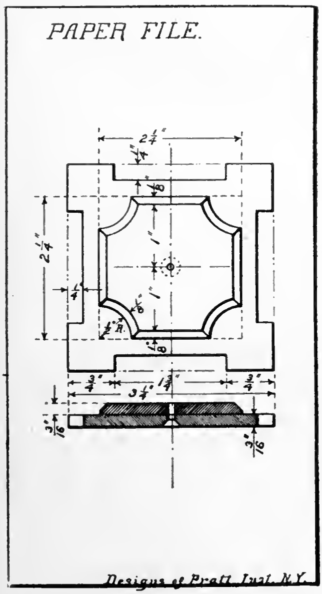
THE GAME OF "TIPCAT" OR "PEG."

The English game of "Tipcat" is played as follows:

A circle, about two feet in diameter is drawn, also a straight line at about twelve feet from the circle. The players draw lots for first turn with the cat. The first player then stands on the line and tosses the cat into or at the circle, the other players standing back of the circle facing the first player. If the cat is tossed into the ring, player No. 1 counts 10 and has another turn to toss, continuing tossing and counting 10 until he misses. When he finally misses by tossing the cat outside the ring, the player who first picks up the cat has the privilege of "tipping the cat" by hitting the pointed end with a bat and then striking the cat as far as he can. Player No. 1 endeavors to catch the cat, if successful he adds 10 to his score. Failure to catch compels player No. 1 to again toss for the ring. Player No. 2, the one who "tipped the cat," counts 10 for each length of the bat measured from the cat to the circle after batting, provided the cat is not caught. 50 or 100 points may constitute a game.

The American game of "Peg" is played in this way:

The peg is marked on the four sides respectively (I), (III,) (V), (X). Players lag to a line for first play. First player lays the peg on the bat and throws it as far as he can. If another player catches the peg first player is "out," and the catcher takes his place. If the peg is not caught the player who gets the peg throws it from the place where it lights, toward the "lag line." If the peg hits the line, or if it lights with the "X" side up, the first player is "out," otherwise the first player has the privilege of tipping and batting the peg as many times as is indicated by the numeral which is up. The other players try to catch the peg and put the first player "out." The number of bat lengths from the peg to the "lag line" count one each to the score of the first player. The first player, instead of batting the peg, may, after tipping it, and while it is still in the air, strike it vertically downward, this feat counts 1,000 to his score, or he may juggle the peg on the bat, each toss vertically upward, counts 1,000 but he must finally bat the peg. Should he miss in juggling, he loses the count, and must give the bat to the next player. Games of 5,000 or 50,000 points are played.



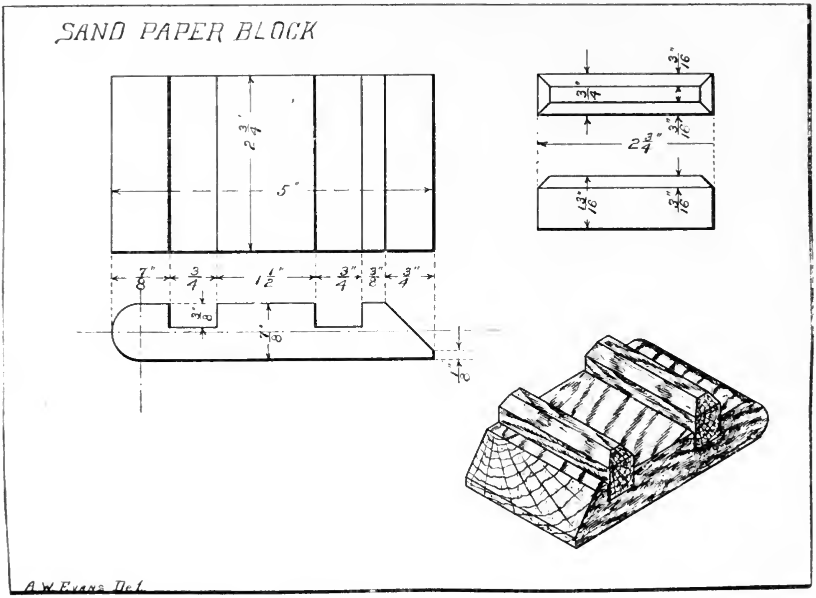
PAPER FILE.

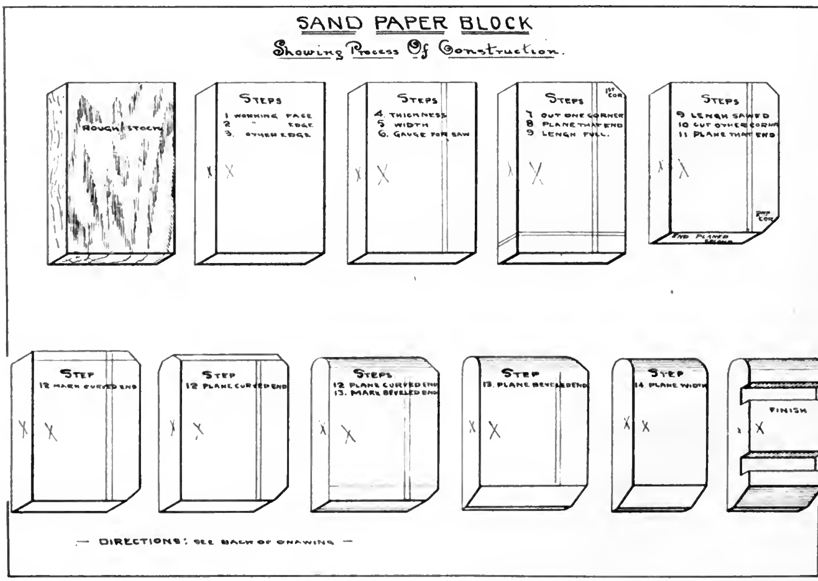
Stock, $\frac{3}{16}$" Bass and Cherry.

Make the small top piece of Cherry and glue in place.

Use an 8d nail for a spindle.

No Drawing.


SAND PAPER BLOCK
A. W. Evans Del.

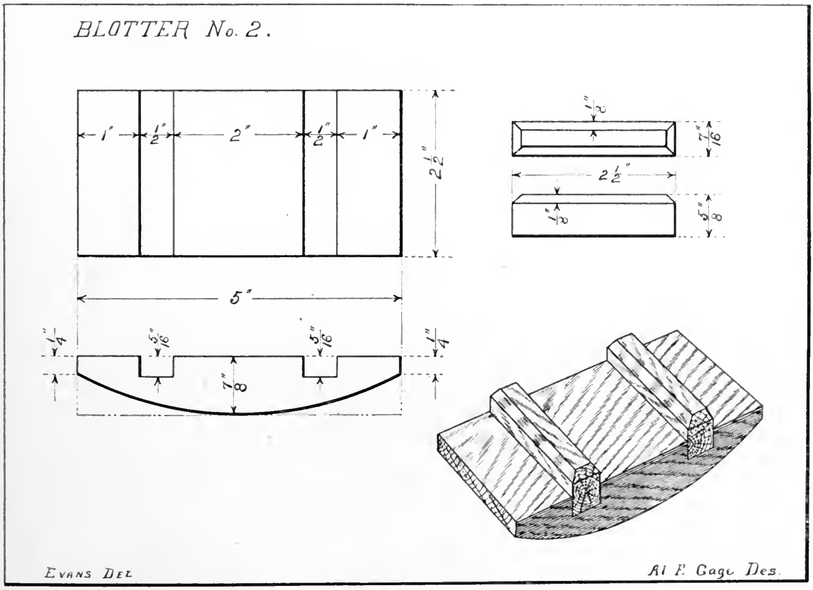

SAND PAPER BLOCK
Showing Process Of Construction.
ROUGH STOCK
STEPS
1 WORKING FACE
2 " EDGE
3. OTHER EDGE
STEPS
4. THICKNESS
5 WIDTH
6. GAUGE FOR SAW
STEPS
7 CUT ONE CORNER
8 PLANE THAT END
9 LENGTH FULL.
STEPS
9 LENGTH SAWED
10 CUT OTHER CORNER
11 PLANE THAT END
STEP
12 MARK CURVED END
STEP
12 PLANE CURVED END
STEPS
12 PLANE CURVED END
13. MARK BEVELED END
STEP
13. PLANE BEVELED END
STEP
14. PLANE WIDTH
FINISH
— DIRECTIONS: SEE BACK OF DRAWING —

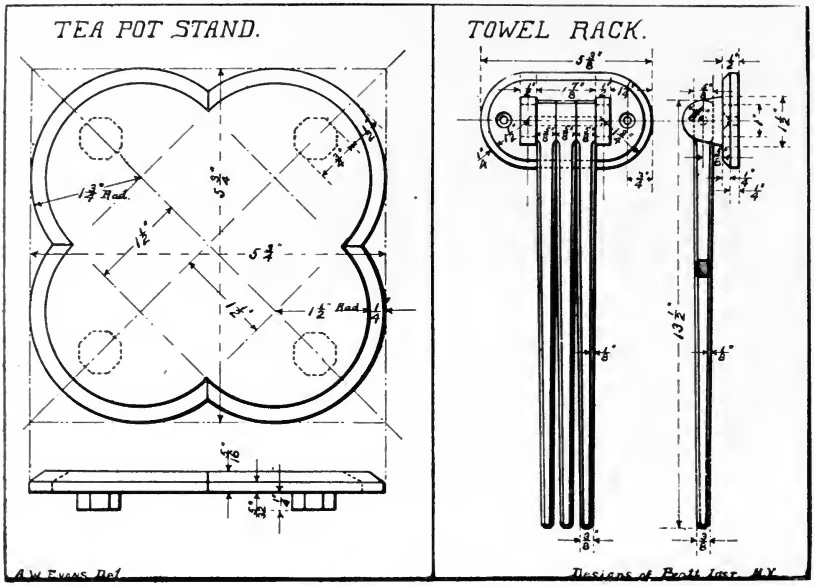
SAND PAPER BLOCK.

1. Plane the working face and mark it X.
2. Plane the working edge and mark it II.
3. Plane the other edge.
4. Gauge the thickness on *both edges* and plane to gauge-lines.
5. Gauge the width (do not plane).
6. Gauge for rip-saw $\frac{3}{16}''$ wide (do not saw).
7. Chamfer one corner (ask teacher which).
8. Plane this end *square*.
9. Measure length and mark with a knife-line.
10. Saw off.
11. Chamfer.
12. Plane this end.
13. Mark and plane the curved end.
14. Mark and plane the beveled end.
15. Saw and plane to the width.

FINISH.

1. Measure and mark gains on W. F. (use knife-lines).
2. Carry the lines down both edges.
3. Gauge the depth of the gains.
4. Saw between the lines, at a little distance from them (cut nearly to gauge-lines).
5. Chisel carefully to the lines.
6. Make wedges.





TEA POT STAND.

Stock, 3/8″ Oak.

An exercise in the use of the chisel and turning-saw.

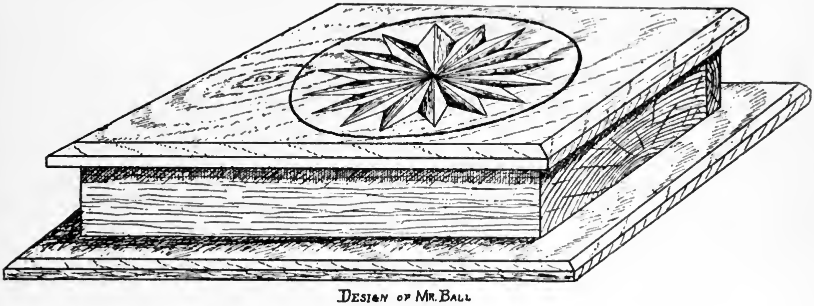
The planing of the board to 5/16″ thick should be made a leading feature.

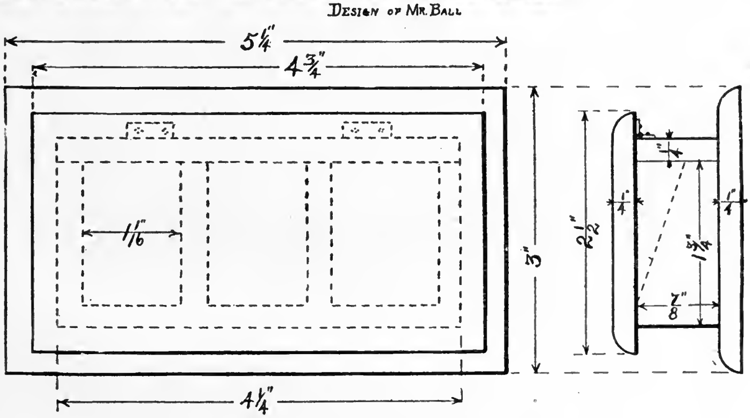
Drawing as shown.

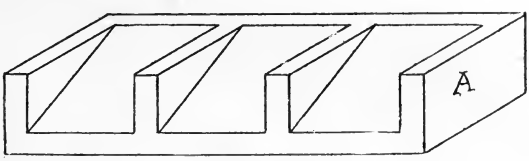
TOWEL RACK.

Stock, 1/2″ Oak for back and brackets; 7/8″ Oak for arms..

Drawing of details.





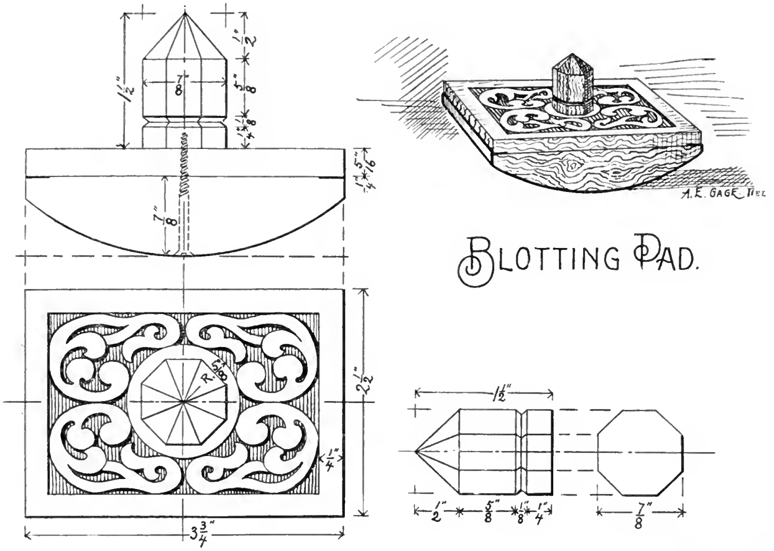


STAMP BOX.

Stock, Gumwood, or Oak.

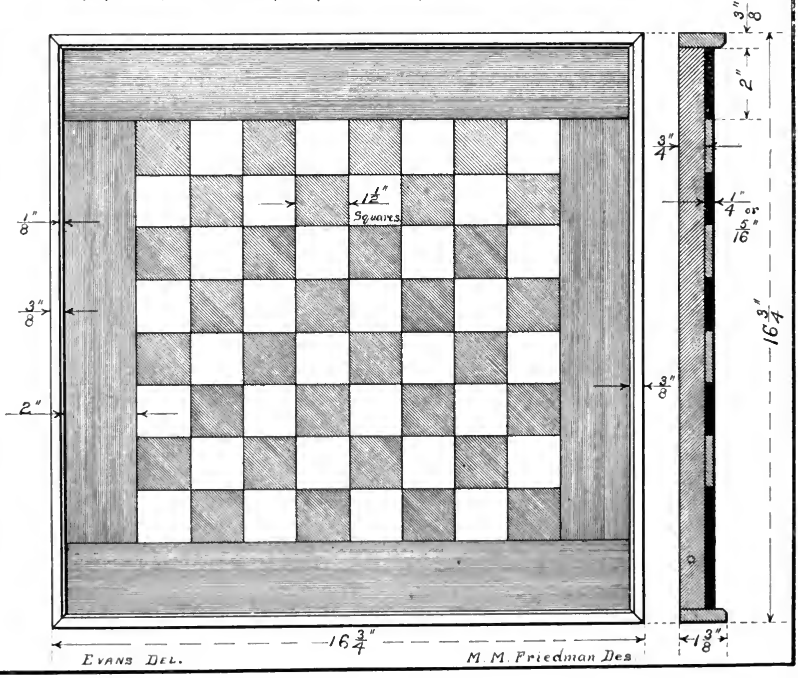
Make the block (A), ⅞" x 1¾" x 4¼", sawing and chiseling the slanting grooves. Glue on the back piece, ¼" thick, and glue and nail the bottom in place. The top is fastened as shown with ½" brass hinges. This model should be elaborately carved on the top and around the body. The edges of cover and base may be either chamfered as shown in the picture or rounded as shown in the working drawing.

Working Drawing.



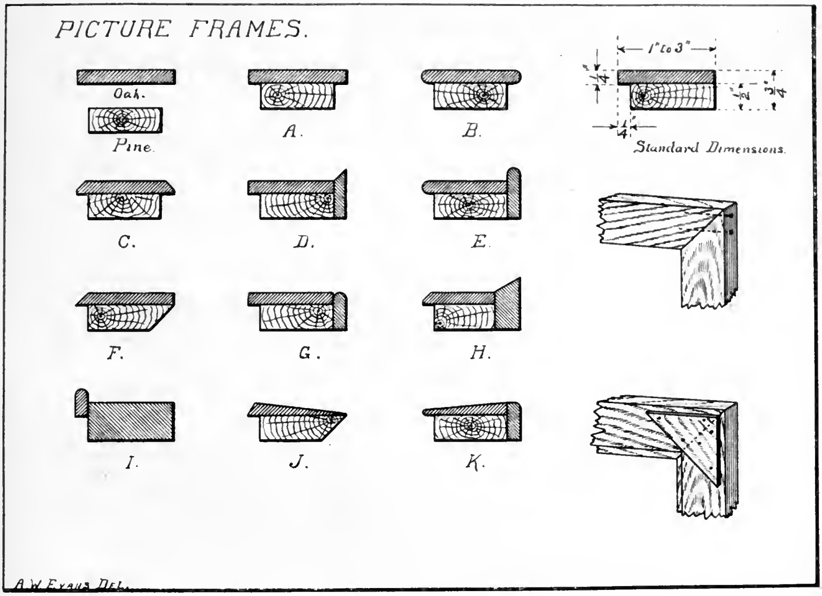
BLOTTING PAD.

CHESS OR CHECKER BOARD.



EVANS DEL.

M. M. Friedman Des.



PICTURE FRAMES.

All picture moulding is to be made of ¼″ Oak and ½″ Pine, as indicated on the drawing, which shows only a few sections that may be built up in this way. Sections I and H show the use of ⅞″ Oak, which is allowable. *All frames are to be made with the mitre joint and fastened together with glue and brads as is indicated in the isometric drawings.

The width of picture moulding may be made from one to three inches as shown by the "Standard Dimensions" Drawing.

1. Plane a tried edge on one of the ¼″ Oak boards and gauge the width of the moulding.
2. Rip off this strip and plane to the gauge-line.
3. Shape the edge or edges, according to the design selected.
4. In the same way prepare a strip of equal length for the outer

---

* Frames of greater width than three inches may, however, be made with the doweled butt joint, this form being considered more artistic for heavy frames.

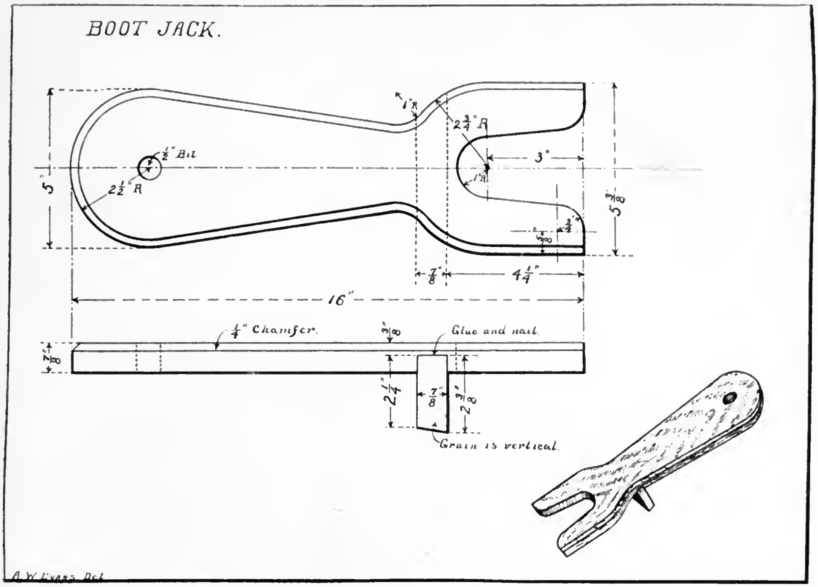
edge, if the design requires this third piece, and also prepare the ½″ pine base piece.

5. Glue and brad the strips together using as few brads as possible. (The brads should be set).
6. Clean the moulding with sandpaper, and finish according to the directions for finish.
7. Mark the joints with the bevel and saw apart.

FINISH.

1. *Dead Black.* Fill with any dark filler and finish with two coats of "Drop-black" ground in Japan. (This drop-black is a flat-drying coach finish.)
2. *Glossy Black.* Polish the above with floor-wax.
3. *Mottled.* Color with either wood-stain or drop-black, and then fill with a light colored filler. (May be polished with wax if desired.)
4. *Green, Brown,* or any color which requires stain should be filled after coloring.

Two coats of shellac may be used over any of the above.



BOOT JACK.

Stock, 7/8" x 6" x 20", Oak or Birch.

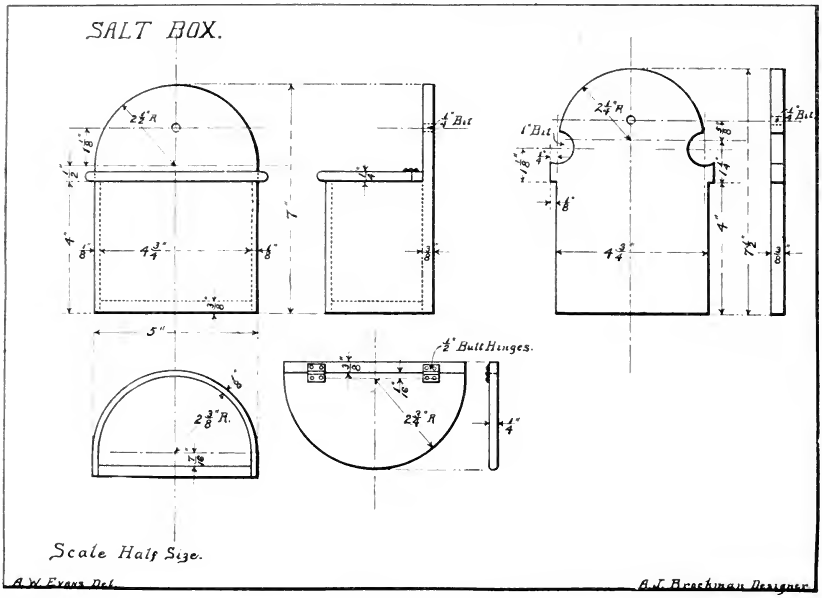
1. Plane one edge and one end.
2. Gauge width and center line.
3. Lay off curves on one side and the lines for mortise on the opposite side, taking all measurements from the planed edge and end.
4. Plane to width.
5. Saw nearly to curves with turning-saw and finish with spoke-shave and files.
6. Square lines on each edge for mortise and gauge the depth of mortise.
7. Saw and chisel mortise, fitting it to thickness of waste piece at end which is to be used in making the brace.
8. Mark lines for chamfer, on edges with marking-gauge and on top with thumb-gauge.
9. Bore hole.
10. Fit the brace or cleat, being particular that the bevel end will rest firmly on floor when in position for use.

The bevel end of brace should be very carefully planed and tested with the T Bevel and trysquare.

11. Glue and nail together.
12. Clean and finish with shellac.

Use wood-filler on Oak before using shellac.

General Drawing.



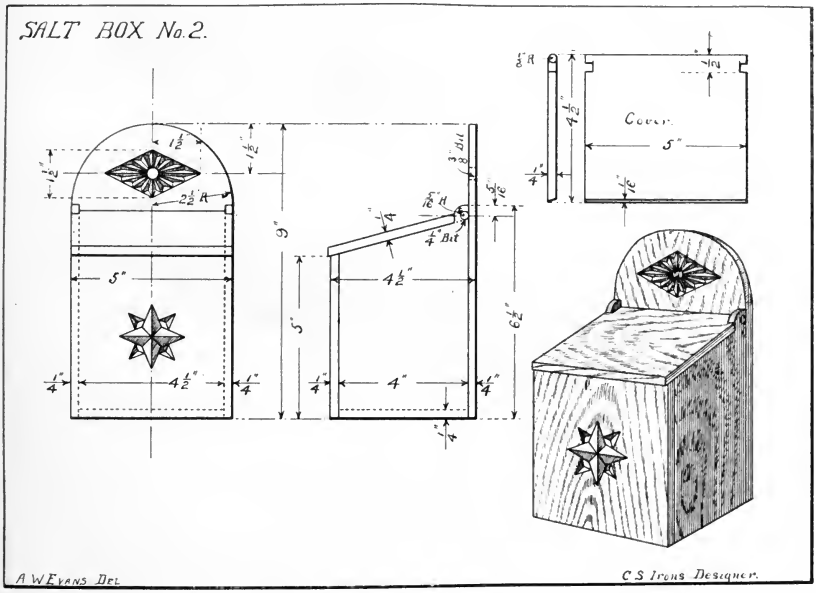
SALT BOX No. 1.

Stock, ½" x 6" x 16", s. 2 s., Pine and ⅛" Basswood.

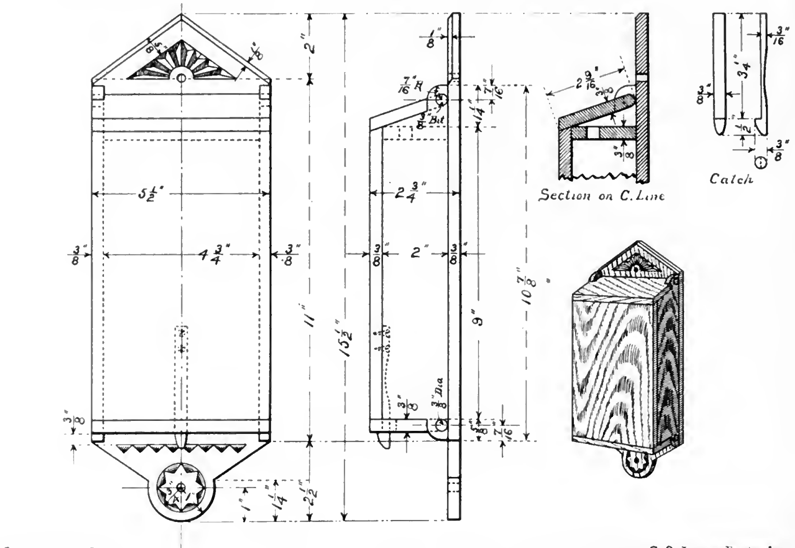
1. Plane tried edge and gauge width.
2. Saw off near gauge-line, saving the narrow strip for the rail to which cover will be hinged.
3. Plane to gauge-line and lay off the back with compass and knife-lines.
4. Saw off and finish back with plane and chisel, then gauge and plane to required thickness.
5. Make two bottom pieces in the same way as above, one to be used to hold the basswood in shape at top while it is drying.
6. Make cover and rail and fasten together with hinges.
7. Fasten base to back.
8. Prepare Basswood by planing to correct length but leaving the width greater than is required.
9. Soak the Basswood in water for at least one hour.

10. At this point design and apply ornamentation to top of the back: (either punching or chip-carving may be used.)
11. Fasten Basswood at one edge and carefully bend to shape around the base and the extra base piece which is to be inserted at top.
12. Fasten in this position with a cord but do not glue and nail to place until Basswood is thoroughly dry.
13. Fasten with brads and glue and clean with sandpaper.
14. Shellac.

General Drawing.



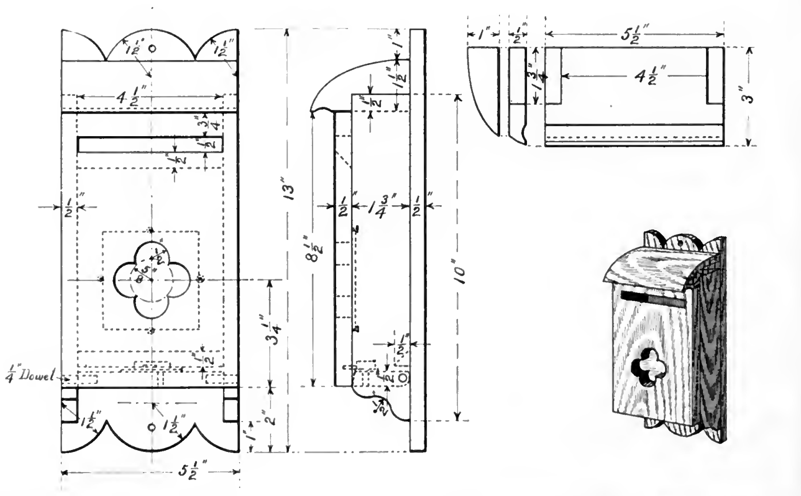
LETTER BOX No. 1.



A. W. Evans Del.

C. S. Irons Designer

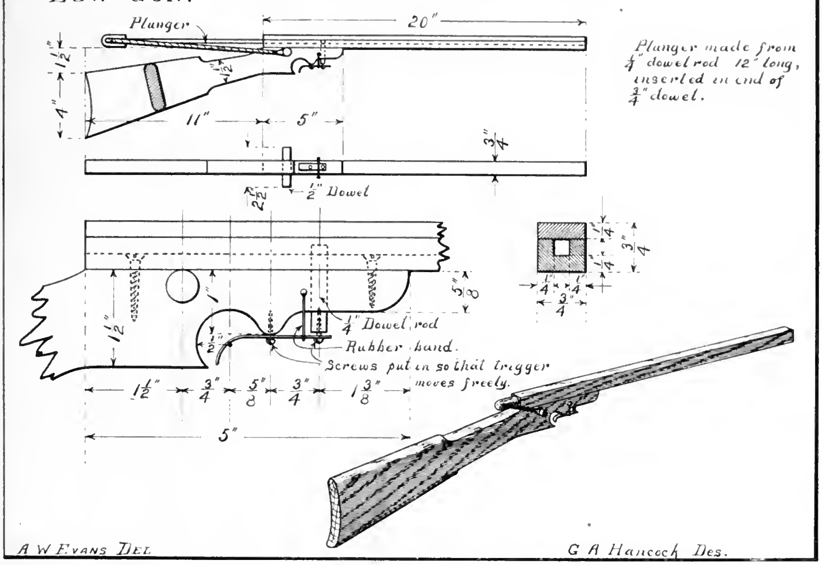
MAIL BOX.



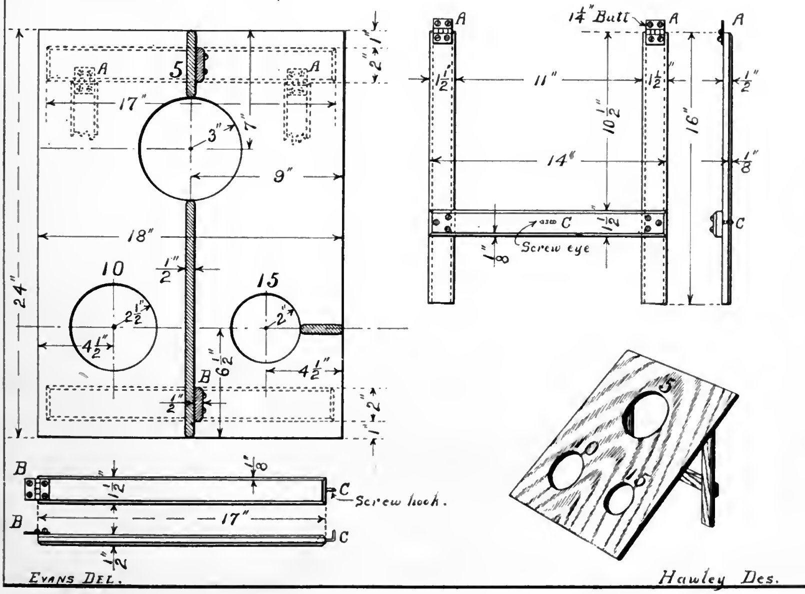
A. W. Evans Del.

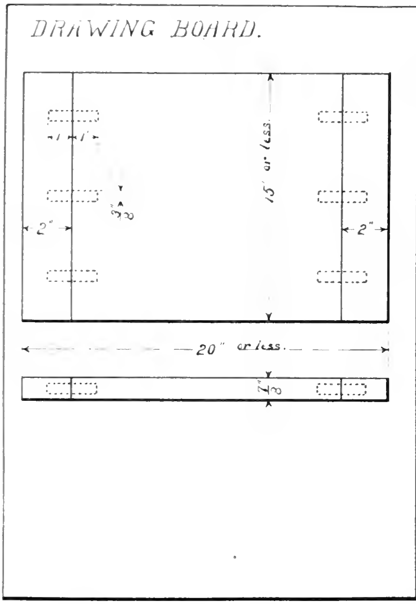
Kinney and Druich Designers.

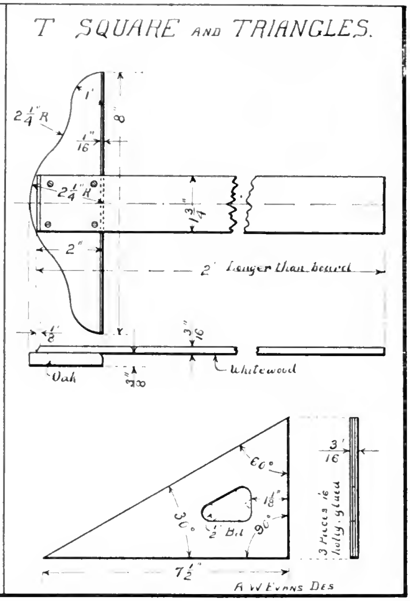
BOW GUN.

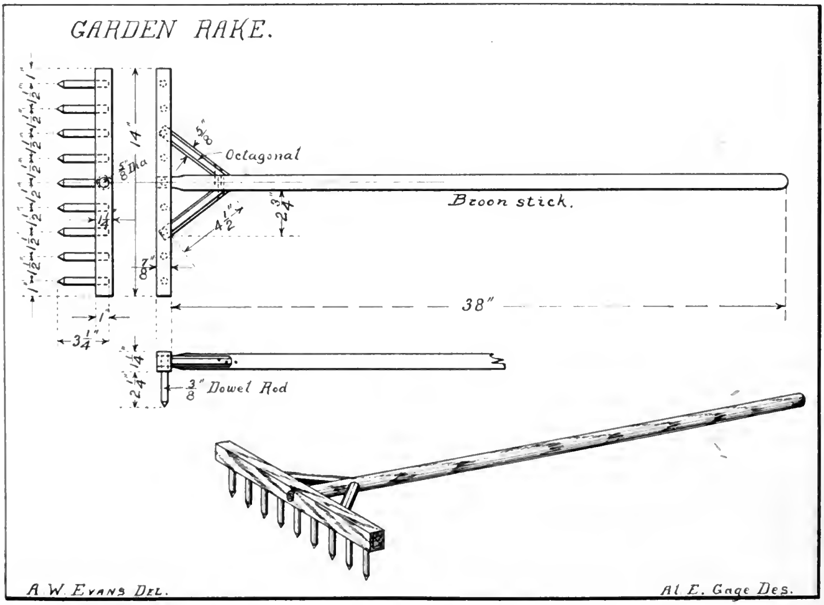


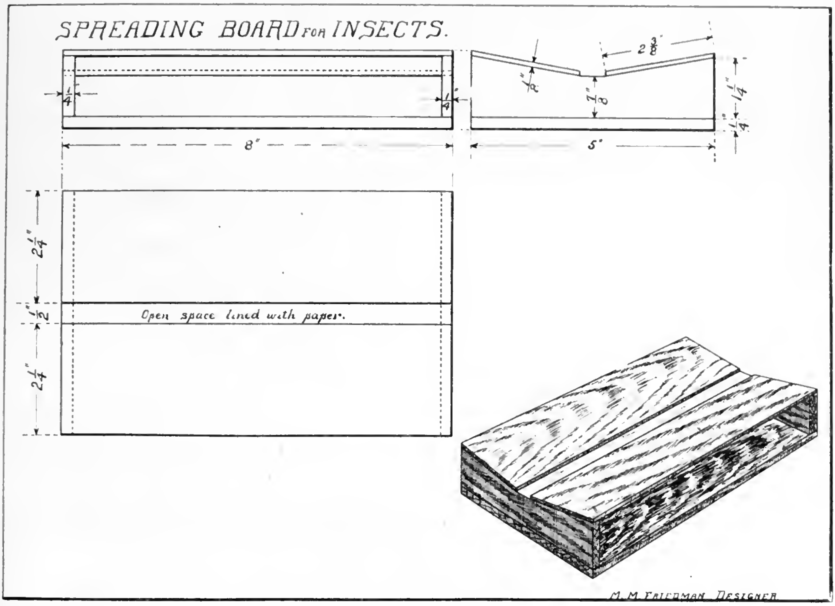
FABA-BAGA BOARD.

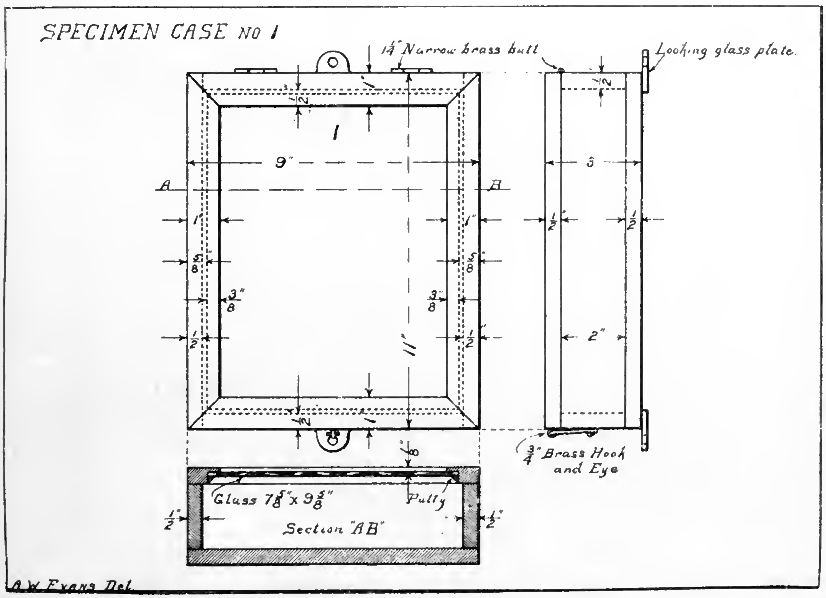


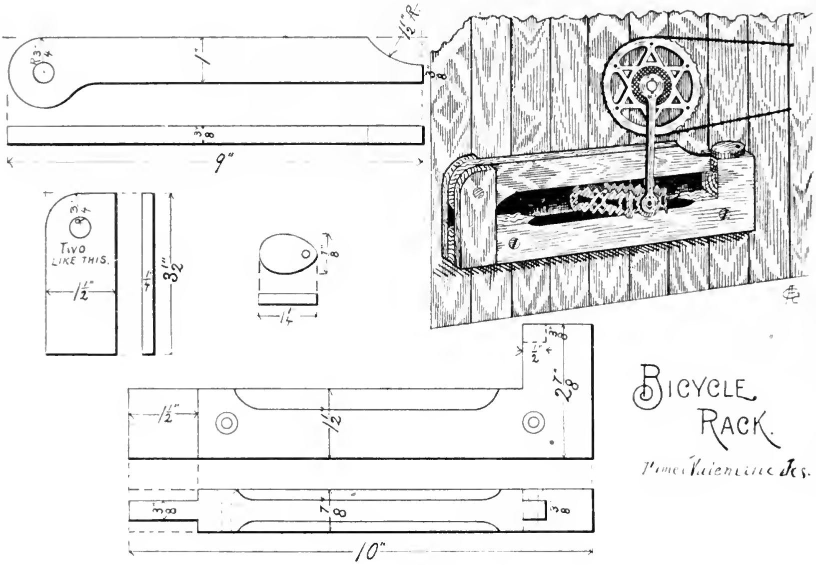

DRAWING BOARD.
15" or less.
2"
2"
$\frac{3}{8}$"
1" 1"
20" or less.
$\frac{7}{8}$"


T SQUARE AND TRIANGLES.
$2\frac{1}{4}$" R
1"
8"
$\frac{1}{16}$"
$2\frac{1}{4}$" R
$1\frac{3}{4}$"
2"
2" Longer than board
$\frac{1}{8}$"
$\frac{3}{16}$"
Oak
$\frac{3}{8}$"
Whitewood
60°
30°
90°
$1\frac{1}{8}$"
$\frac{1}{2}$" Bit
$7\frac{1}{2}$"
$\frac{3}{16}$"
3 Pieces 16 holly. glued
A W Evans Des

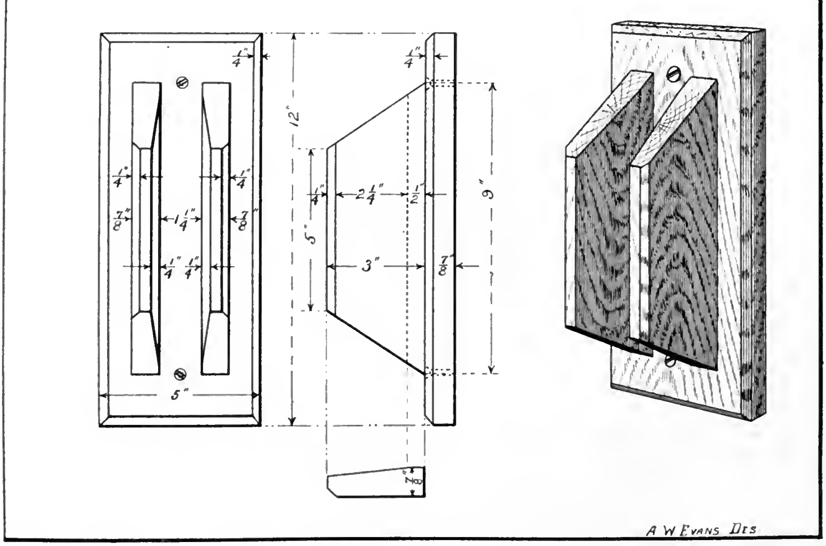

GARDEN RAKE.
14"
$\frac{5}{8}$"
Octagonal
$\frac{5}{8}$" Dia
$\frac{1}{4}$"
$2\frac{3}{4}$"
$4\frac{1}{2}$"
$\frac{7}{8}$"
Broom stick.
38"
1"
$3\frac{1}{4}$"
$1\frac{1}{4}$"
$2\frac{1}{4}$"
$\frac{3}{8}$" Dowel Rod
A. W. Evans Del.
Al. E. Gage Des.


SPREADING BOARD FOR INSECTS.
8"
5"
2 3/8"
Open space lined with paper.
2 1/4"
1/2"
M. M. FRIEDMAN DESIGNER

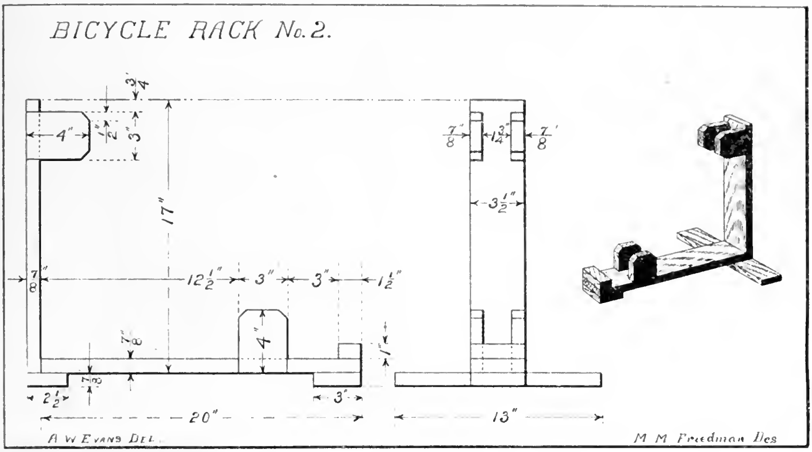

SPECIMEN CASE NO 1
1 1/4" Narrow brass butt
Looking glass plate.
9"
11"
A
B
2"
3/4" Brass Hook and Eye
Glass 7 5/8" x 9 5/8"
Putty
Section "AB"
A. W. Evans Del.



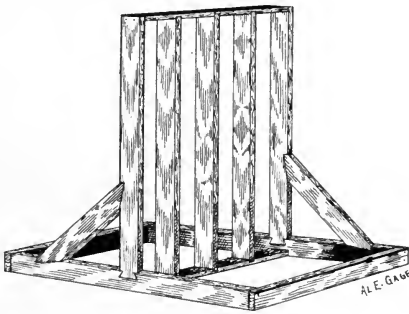
Bicycle Rack.

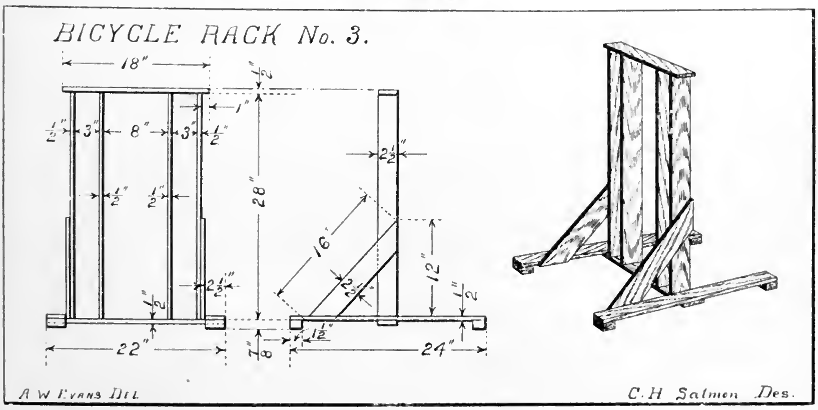


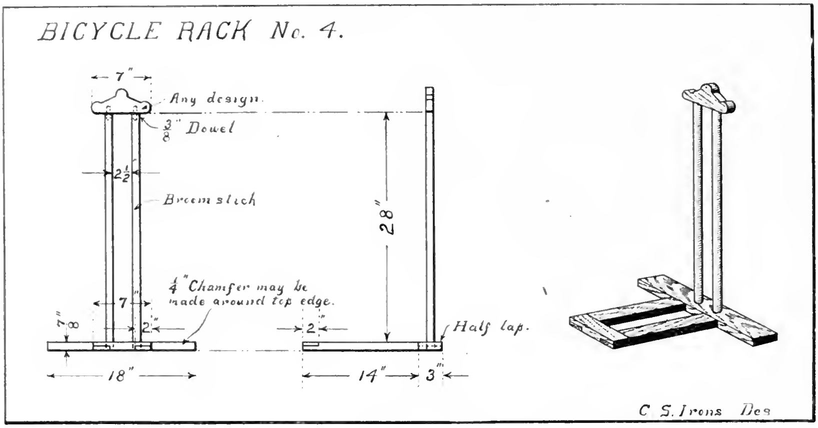
BICYCLE RACK No. 1.

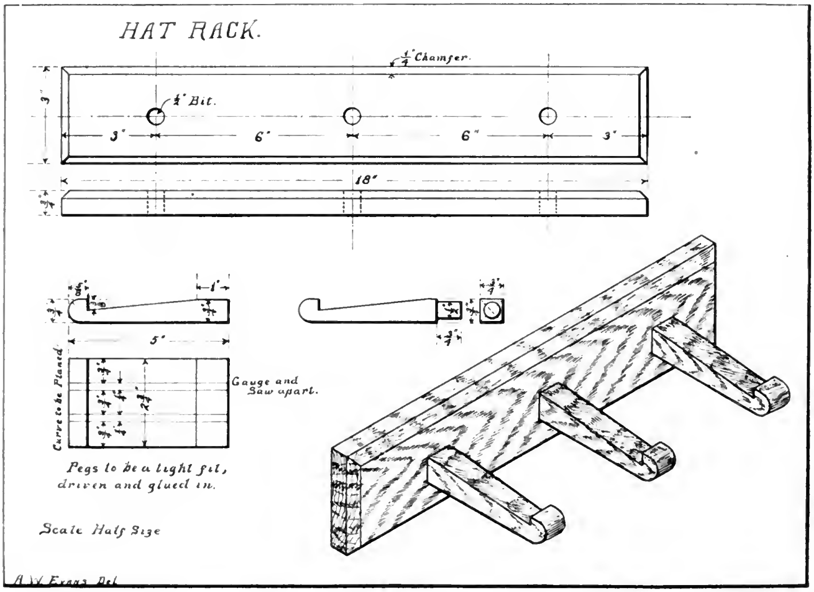


Bicycle Rack.









HAT RACK.

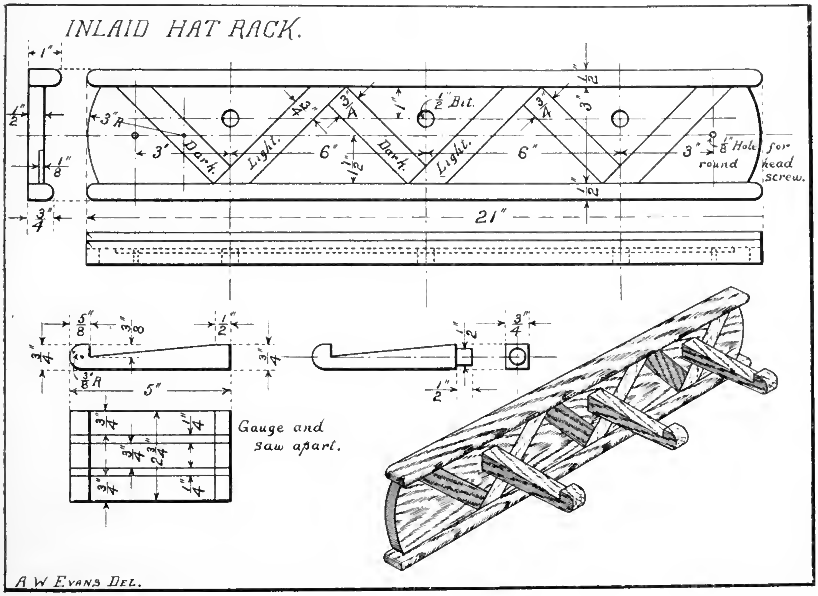
Stock, ⅞" x 3½" x 24", s. 2 s., Pine.

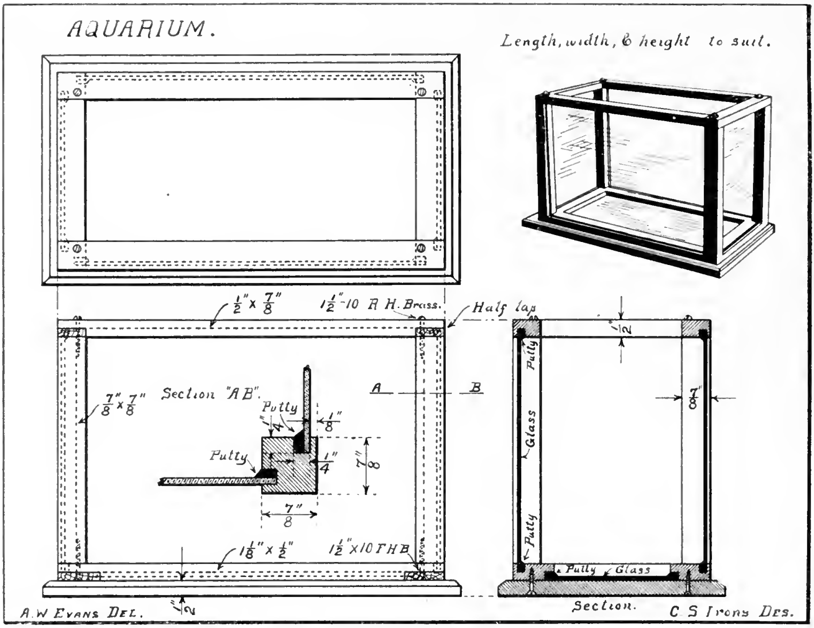
The back is intended as an exercise in planing and as a basis for decoration either by means of chip-carving or back-ground punching.

The pegs are to be made as shown in drawing and are intended as strictly a chisel exercise.

The pegs may be wedged, in addition to gluing.

General Drawing (not shown.)


INLAID HAT RACK.
Dark.
Light.
Dark.
Light.
6"
6"
3"
3"
21"
1/2" Bit.
3"R
1/8" Hole for round head screw.
Gauge and saw apart.
5"
A W Evans Del.



AN AQUARIUM FOR THE SCHOOL-ROOM.

By Dr. H. H. Wilder, Northampton, Mass.

It seems rather a pity that the word "aquarium" should be so generally associated with a large globe of clear water, round which a few goldfish lazily disport themselves, at times distorted out of all recognition, or magnified to colossal proportions by the deceitful refraction of the spherical surface. To a true lover of nature there is something woefully unsatisfactory about such a globe,—unsatisfactory because it corresponds to nothing in nature, and does not even suggest nature. The first endeavor in making a good school aquarium is to make it natural, make it a true sample of some real pond, where everything grows and thrives as nearly as possible as it does out of doors in the real world.

For purposes of observation, an aquarium with straight sides is better than a globular or cylindrical one. (A very practical one is here shown.) There are two sizes, the larger with a capactiy of five gallons, its base 13″ x 8″, and its height 13″; and the smaller 2½ gallons, and its dimensions 10½″ x 6½″, and 10″ high.

SOIL AND PLANTS.

To prepare such an aquarium, collect first some good garden soil, a small quantity of clean sand, and a few handfuls of small round pebbles about the size of beans. Then go to some pasture pond or slow running brook, and dig up a few sprays of small sorts of aquatic plants, taking care to get the roots and a little of the soil.

Almost any truly aquatic green plants will do; but chara and anacharis are among the best. If you can find any duck-weed, a a little floating plant, each plant consisting of a few small oval leaves, and a short hanging root, take some of that also. Take also a little of the floating green slime, which is not a dangerous, malarial scum, but a beautiful water plant, and a fine food for snails and some other aquatic animals. When all the above have been brought together, put the aquarium in its permanent position and place in the bottom 1½″ to 2″ of the garden soil. Wet this thoroughly, and put in it the water plants.

THE WATER.

Now add water until there is about an inch of it above the surface of the soil. This will be very muddy at first, but if the soil is of the right sort and not too clayey, it will settle fairly well in half an hour. Now add the sand a little at a time until you have a layer of perhaps ½″ to 1″ covering the soil, and then add water very carefully until the aquarium is full. In adding this water, pour it slowly down the sides, and not always in the same place, to avoid making holes in the sand. This water should stand a day and then be carefully syphoned off with a rubber tube, and clear water added. While the water is off, strew small pebbles on the surface. Change the water every day or half-day until it seems quite clear. In some cases a week may be necessary in order to accomplish this. Finally add the floating plants, and the aquarium is ready to be stocked.

STOCKING THE AQUARIUM.

The stocking of an aquarium is a chapter in itself, and the selection of animals depends on the taste or object of its owner. An aquarium of the larger of the two sizes mentioned, and well stocked with vegetation, will support from eight to ten goldfish, two large tadpoles, and a half dozen snails.

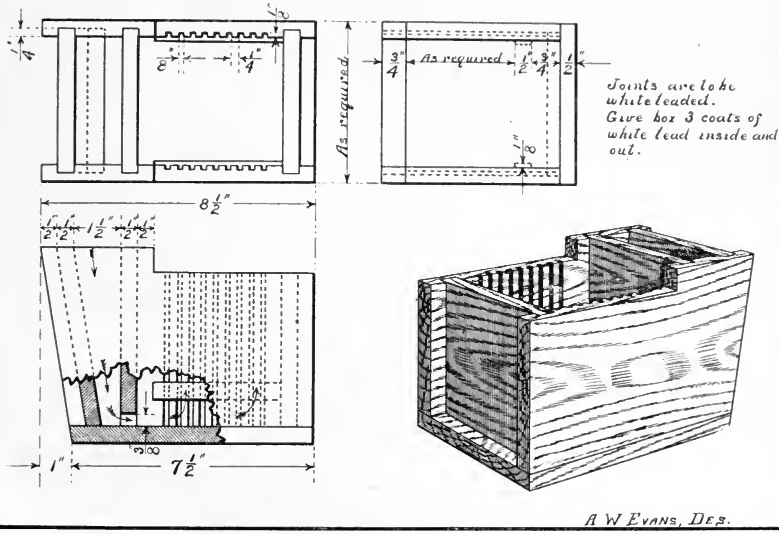
Small bullheads, minnows, or other native fish will answer as well as goldfish, and may prove even more interesting. Such an aquarium is almost self-supporting, but it is better to take out and replace about two pitchers of water every two or three weeks, or as often as the fish begin to lie near the surface, and gasp.

A few bits of coral or bright colored shells placed in the bottom may make the aquarium more attractive, but hardly as true to nature as without them.

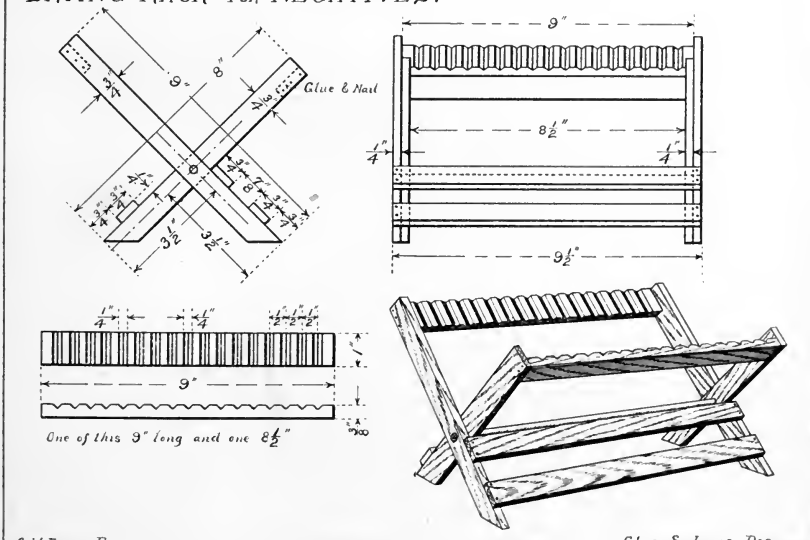
The fish will thrive better if they are fed every day or two with a few crumbs of "goldfish-food" which may be obtained at any bird store. A ten-cent package will last a year.

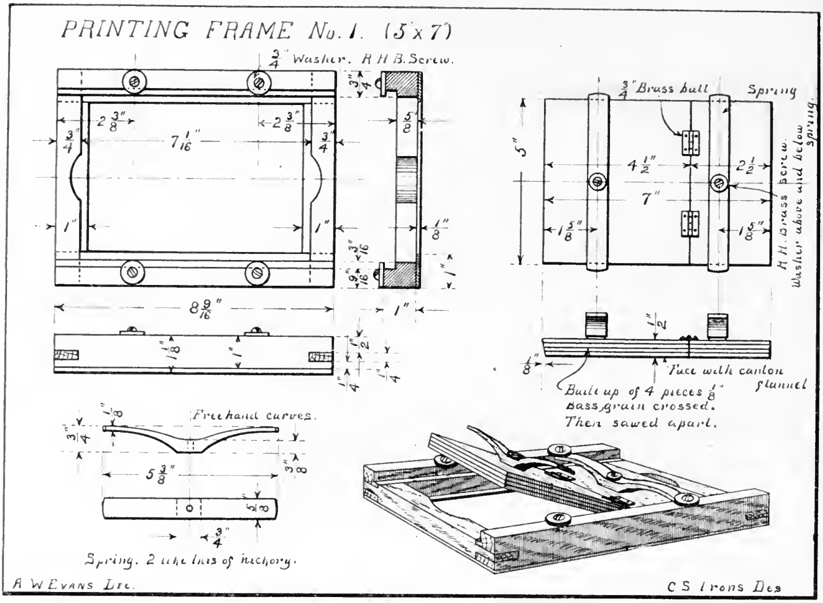
A tiny grotto may be made of a few large stones placed in one corner: and such a retreat would be much appreciated by the fish.

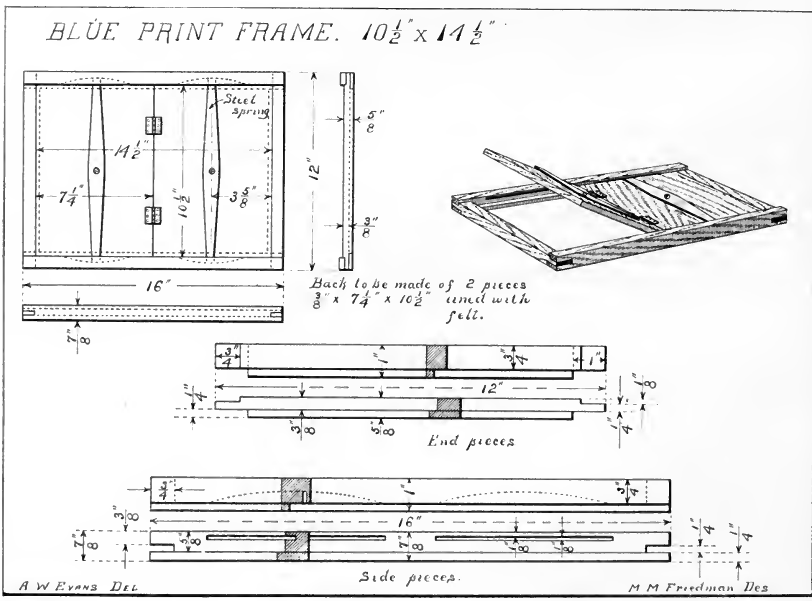
NEGATIVE WASHING BOX.



DRYING RACK FOR NEGATIVES.




PRINTING FRAME No. 1. (5 x 7)
3/4" Washer. R H B. Screw.
3/4" Brass butt
Spring
R.H. Brass Screw. Washer above and below spring.
Face with canton flannel
Build up of 4 pieces 1/8" Bass, grain crossed. Then sawed apart.
Freehand curves.
Spring. 2 like this of hickory.
A W Evans Del.
C S Irons Des


BLUE PRINT FRAME. 10 1/2" x 14 1/2"
Steel spring
Back to be made of 2 pieces 3/8" x 7 1/4" x 10 1/2" lined with felt.
End pieces
Side pieces.
A W Evans Del
M M Friedman Des

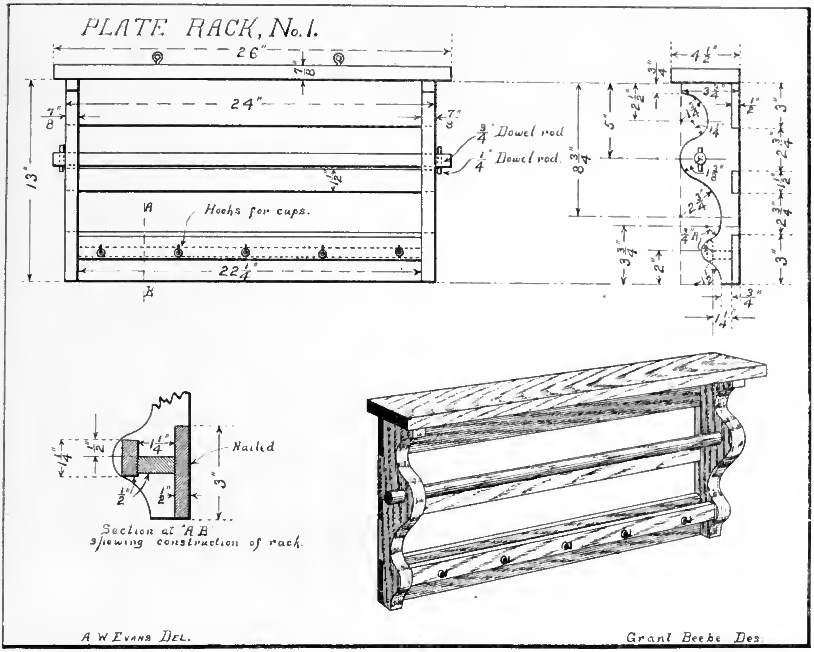


PLATE RACK, No. 1.
26"
24"
$\frac{7}{8}$"
13"
$\frac{3}{4}$" Dowel rod
$\frac{1}{4}$" Dowel rod.
Hooks for cups.
A
B
$22\frac{1}{4}$"
$4\frac{1}{2}$"
$8\frac{3}{4}$"
5"
$3\frac{3}{4}$"
Nailed
Section at "AB" shewing construction of rack.
A W Evans Del.
Grant Beebe Des.

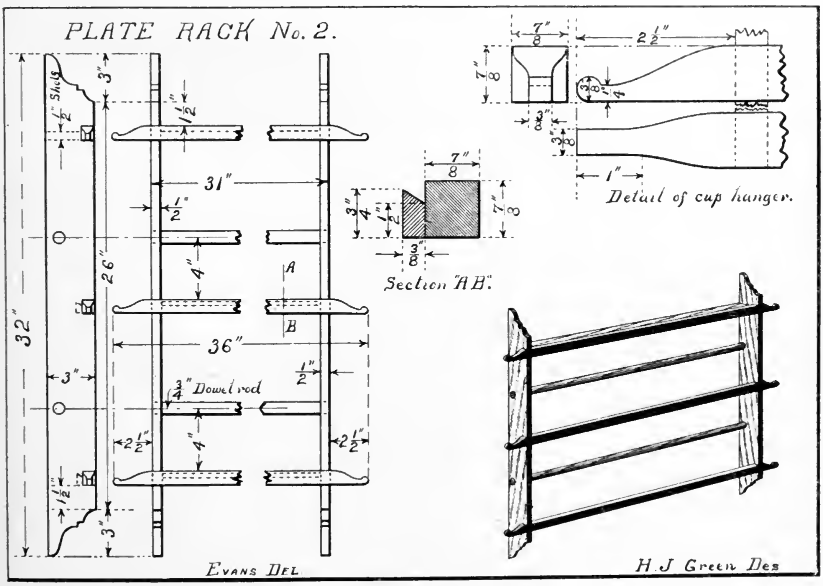
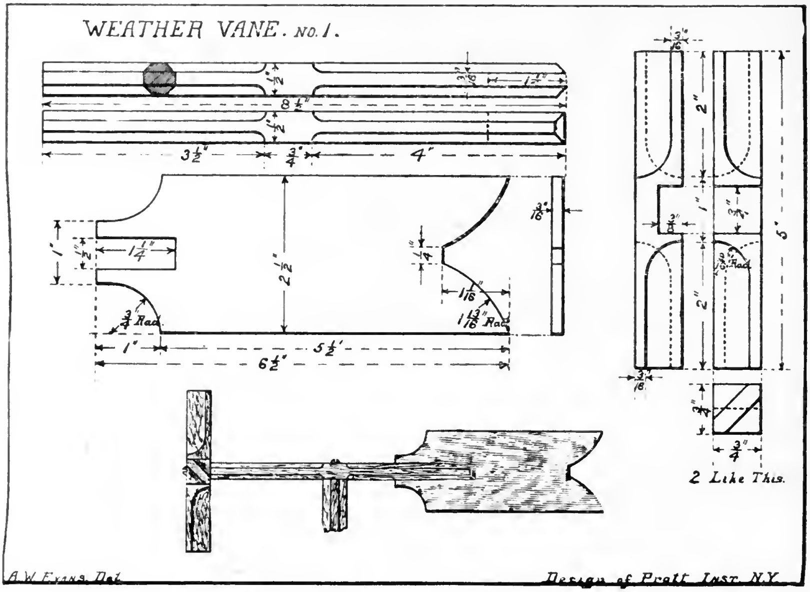


PLATE RACK No. 2.
32"
26"
31"
36"
$\frac{1}{2}$" Shelf
$\frac{3}{4}$" Dowel rod
Section "AB".
Detail of cup hanger.
$2\frac{1}{2}$"
Evans Del.
H.J Green Des.

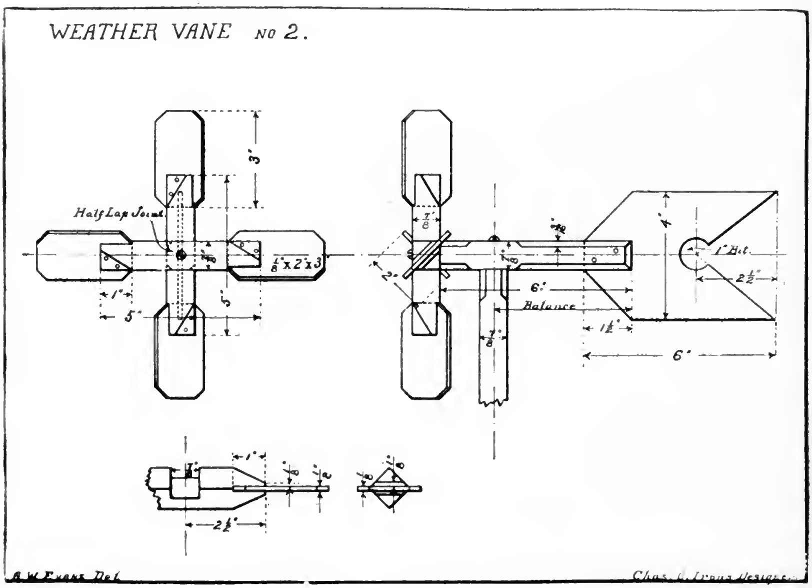


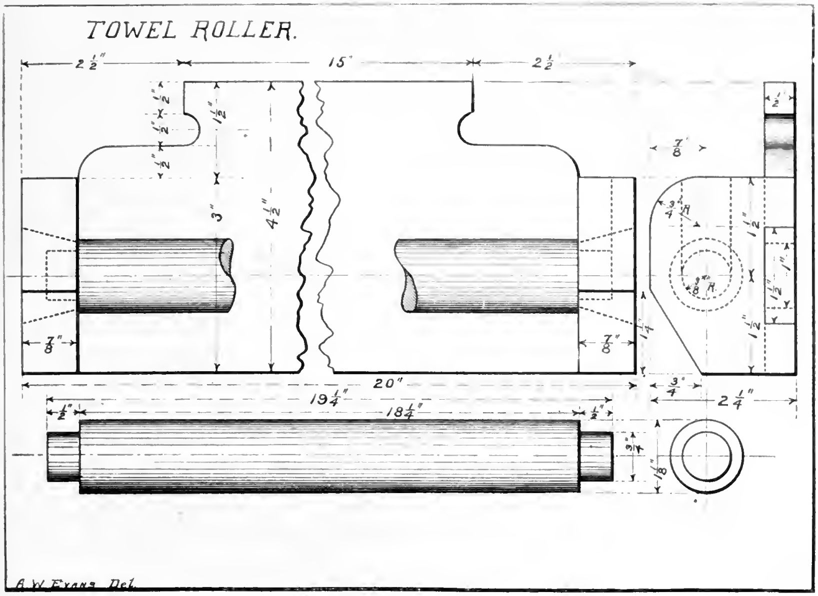
WEATHER VANE No. 1.

Stock, $\frac{7}{8}''$ Pine and $\frac{3}{16}''$ Bass.

The forming of the arms of the wheel and the chamfering of horizontal end post are to be done with the knife.

General Drawing.





TOWEL ROLLER.

Stock, $\frac{1}{2}'' \times 5'' \times 21''$, s. 2 s., Pine, $\frac{7}{8}'' \times 3'' \times 7''$, s. 2 s., Pine, $1\frac{1}{4}'' \times 1\frac{1}{4}'' \times 20''$, Rough Gum.

1. Plane stock for the back to size on edges and ends.
2. Lay off curves and dovetails as per drawing, using only gauge, compass and knife-lines.
3. Bore holes for concave curves at top.
4. Saw out with back-saw and finish with chisel, being particular that the sides and shoulders of dovetails are square with the face.
5. Plane stock for brackets on edges and ends to a greater length than will be required for both brackets and to a width of $2\frac{1}{4}''$.
6. Mark out both brackets on this piece with knife and gauge-lines, so that the ends already planed will serve for the top surface of each.
7. Chisel curve and test with trysquare.

8. Bore holes ½″ deep and groove one bracket as shown.
9. Saw apart and plane to lines.
10. Mark mortises by laying on the dovetail already made and scribing with knife.
11. Square and gauge depth of mortise.
12. Saw exactly to lines and remove stock with chisel.

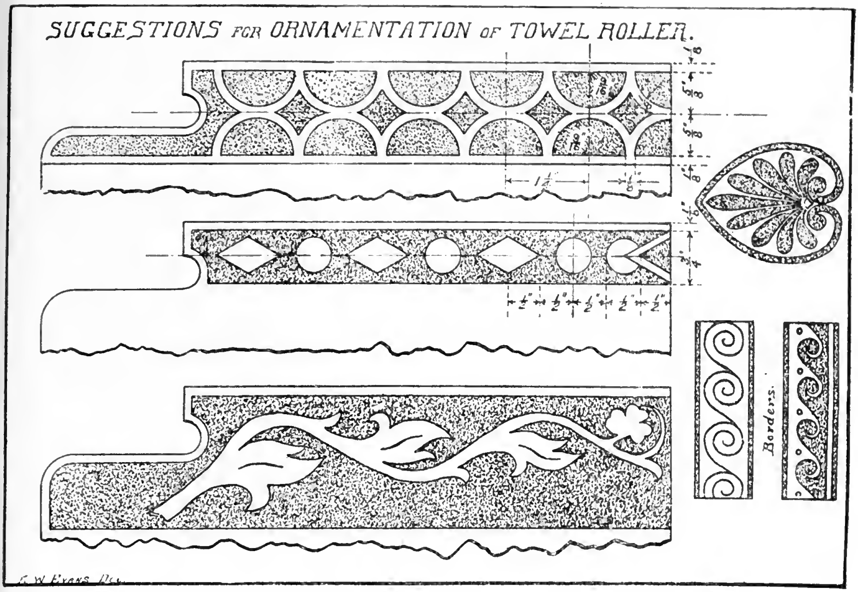
THE ROLLER.

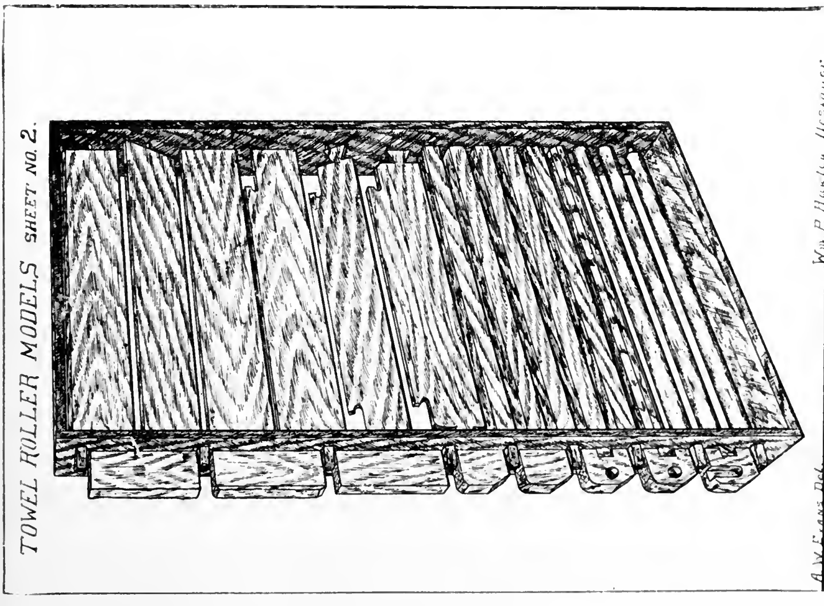
1. Cut square bar to required length.
2. Find center of square bar at the ends by drawing diagonals.
3. Scribe both circles at each end.
4. Draw lines on end of bar tangent to large circles cutting the corners at about 45 degrees.
5. The ends of these lines may be connected by gauge lines on the length of the bar.
6. Plane to octagonal form, requiring that this preliminary work be accurate.
7. Plane to circle.
8. Saw and chisel small ends.
9. Finish roller with sandpaper.

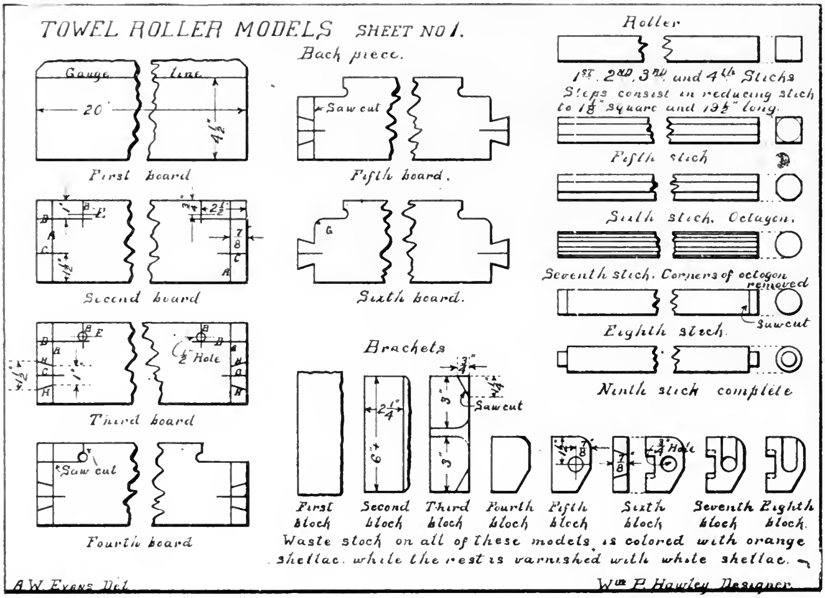
NOTE.—The back is now to be decorated either by means of chip carving or background punching.

10. Clean and glue together.
11. Shellac.

DRAWING.—The drawing for this exercise should consist of details of each part separately, and not as given in above drawing except for advanced pupils.


SUGGESTIONS FOR ORNAMENTATION OF TOWEL ROLLER.
Borders.


TOWEL ROLLER MODELS SHEET NO. 2.



DETAIL DIRECTIONS FOR TOWEL ROLLER.

TO BE PLACED ON TEACHERS SET OF MODELS.

BACK.

1st board.

1. Plane a working face, mark it X, use smoothing plane.
2. Plane a tried edge, mark it X, use jack-plane set very fine.
3. Plane other face, do not mark it, use smoothing plane.
4. Plane a tried end, mark it X, use smoothing plane.
5. Square off 20″ from tried end with knife-line.
6. Saw off $\frac{1}{32}$″ outside of line.
7. Chamfer corner opposite tried edge and plane this end to line.
8. Gauge width.
9. Saw and plane to width.

2nd board.

10. Square off knife-lines A–A and B–B.
11. Gauge lines C-C, D-D and E-E.

3rd board.	12.	Draw circles at F-F with dividers.
	13.	Draw curves at G-G with dividers.
	14.	Mark off dovetails with dividers from center lines C-C.
	15.	Draw knife-lines marked H-H-H-H.
4th board.	16.	Bore holes at F-F with Fostner bit.
	17.	Saw to lines B-B and D-D, use back-saw.
5th board.	18.	Saw to lines H-H-H-H and A-A.
6th board.	19.	Round two corners and finish with chisel and file.

ROLLER.

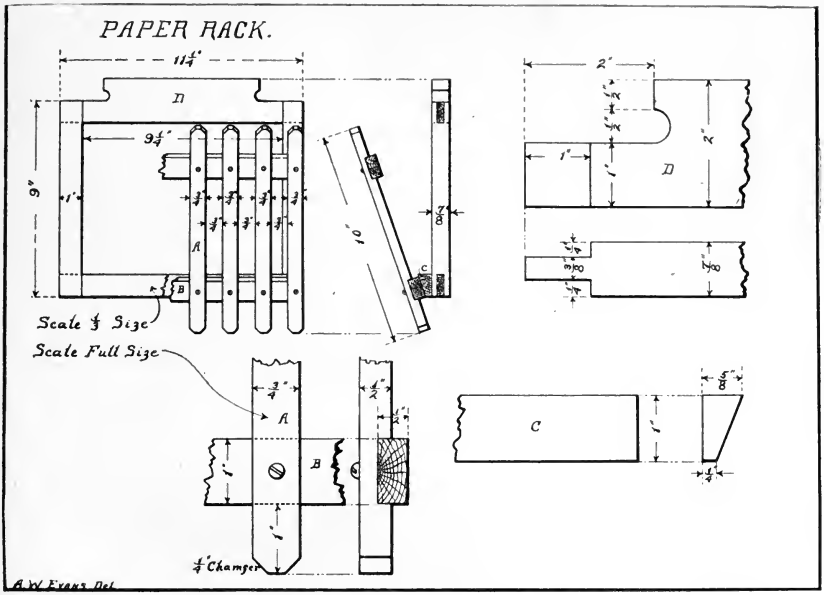
1st stick.	1.	Plane face No. 1.
	2.	Plane face No. 2 square with No. 1.
2nd stick.	3.	Surface off face No. 3.
	4.	Gauge width from No. 2, on No. 1, and on No. 3.
3rd stick.	5.	Plane No. 4, to these lines.
	6.	Gauge width from No. 1, on No. 2, and on No. 4.
4th stick.	7.	Plane No. 3, to these lines.
	8.	Square around each end with knife-line making stick correct length.
5th stick.	9.	Saw ends to these lines, use back-saw.
	10.	Draw diagonals on ends.
	11.	Draw circles on ends with dividers.
	12.	Mark chamfers on ends.
	13.	Gauge chamfers on sides.
6th stick.	14.	Plane corners to gauge-lines.
7th stick.	15.	Plain off corners again, use smoothing plane.
8th stick.	16.	Plane off corners again with smoothing plane.
	17.	Round stick with plane and strip of sandpaper.
	18.	Draw small circles on ends.
	19.	Mark off shoulders with gauge.
	20.	Saw down shoulders, do not saw too deeply.

9th stick.	21.	Work small ends with chisel.
	22.	Finish small ends with file, and saw to ½″ in length.

BRACKETS.

1st block.	1.	Plane working face, and mark it.
	2.	Plane tried edge, and mark it.
	3.	Plane other face.
2nd block.	4.	Chamfer corners opposite tried edge, use plane.
	5.	Plane both ends square.
	6.	Gauge width from tried edge on both faces.
	7.	Mark off length from each end with knife-line.
	8.	Mark off corners with knife-line.
	9.	Draw curves.
3rd block.	10.	Plane width to gauge-line.
	11.	Saw off corners, use back-saw.
	12.	Saw pieces apart.
4th block.	13.	Plane to lines on top ends.
5th block.	14.	Chisel off round corners.
	15.	Lay out holes, make right and left.
6th block.	16.	Lay out mortises on both pieces.
	17.	Lay out roller slot on right hand bracket.
	18.	Saw mortises and roller slot, use back-saw.
7th block.	19.	Finish out mortises and slot with ⅝″ chisel.

Eighth block shows mortise in process of making, also position of hole.

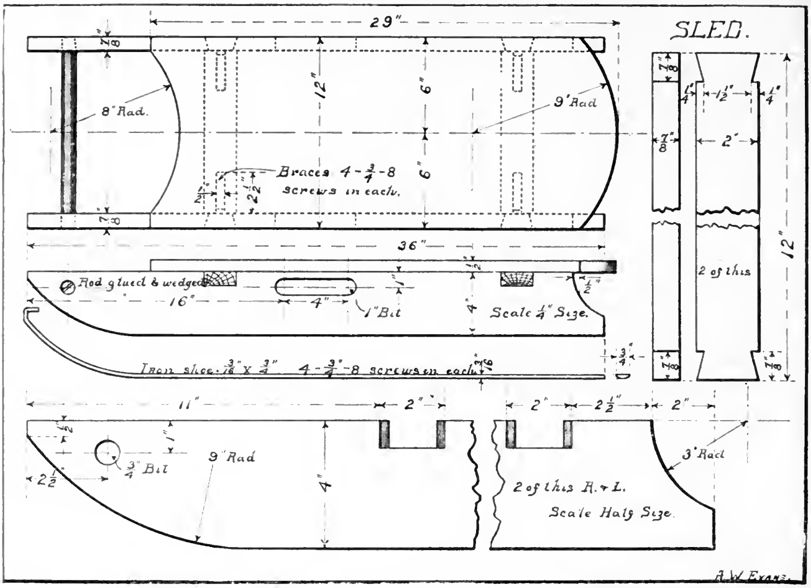


PAPER RACK.

Stock, ½" and ⅞" Pine.

1. Prepare stock for the frame of back D.
2. Join as shown or with open mortise and tenon joints.
3. Make and fasten piece C to back with glue and nails.
4. Make rails B and pickets A for front.
5. Fasten A. & B. with ½" R. H. Brass screws, except the first and last pickets, which will be held to cleat C by 1¼" R. H. Brass screws.
6. Clean with sandpaper and finish with shellac.

General drawing as shown.



SLED No. 1.

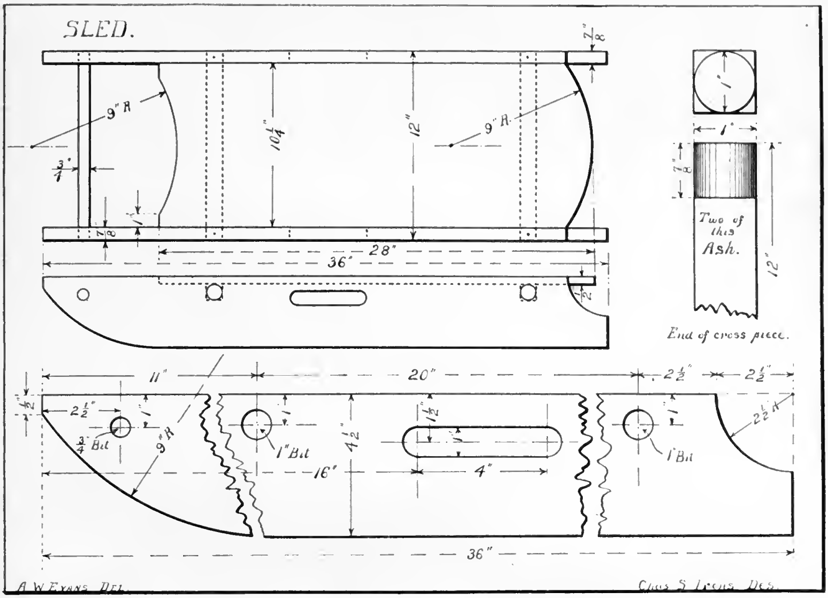
Stock, 7/8" x 9" x 37", s. 2 s., Pine, 7/8" x 5" x 12½", s. 2 s., Pine, ½" x 13" x 30", s. 2 s., Pine, 1" x 1" x 13" rough Ash.

Iron corner braces are furnished.

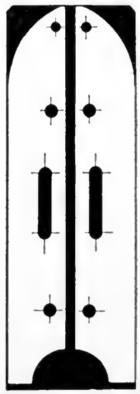
Iron shoes will be supplied at cost to pupils when desired.

1. Plane both edges of large 7/8" board and lay off both runners, using the planed edges for base of runners.
2. Saw apart and finish to lines, but do not mark or cut dovetail mortises.
3. Make dovetail braces and from these scribe the mortises in the runners.
4. Glue and nail dovetail braces to place.
5. Make top and glue and nail to place.
6. Plane the ash rod in the same manner as roller in Towel Roller. This rod should be nailed into place, as the wedges shown in the drawing are liable to split the runners.
7. Screw on iron corner braces.
8. Finish with shellac. (No shellac to be used inside).

Detail Drawings.

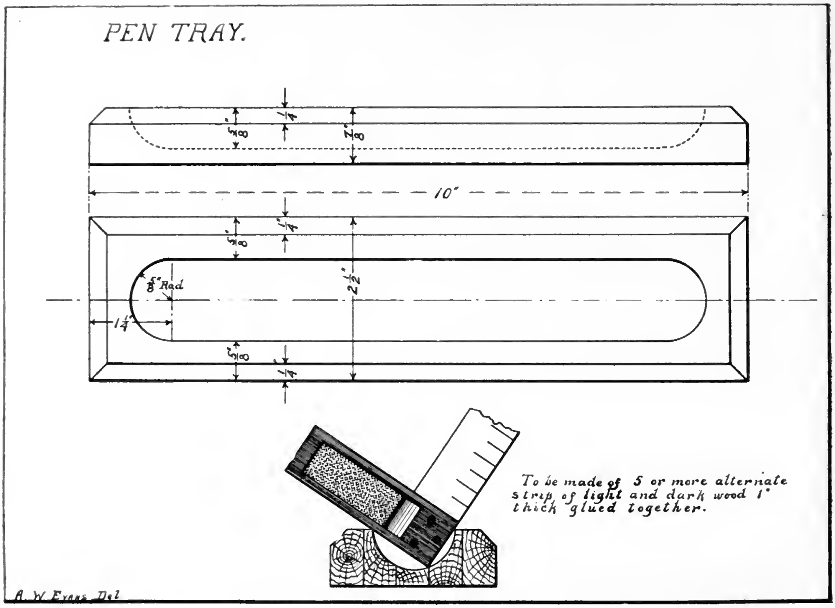


SLED No. 2.



Stock, 7/8" x 10" x 37", s. 2 s., Pine, 1/2" x 11" x 30", s. 2 s., Pine, 1 1/4" x 1 1/4" x 13" rough Ash.

1. Plane both edges 7/8" board and lay off runners, using planed edge for base.
2. Block plane front end of runner and finish to curved line.
3. Bore holes for cross-pieces and handles. Saw out and finish handles.
4. Saw runners apart and finish back to lines.
5. Plane up cross-pieces and fit to auger holes.
6. Make top.
7. Clean parts with fine cut of plane, glue and nail together.
8. Screw on corner braces and shoe irons.
9. Finish with shellac (outside only).



PEN TRAY No. 1.

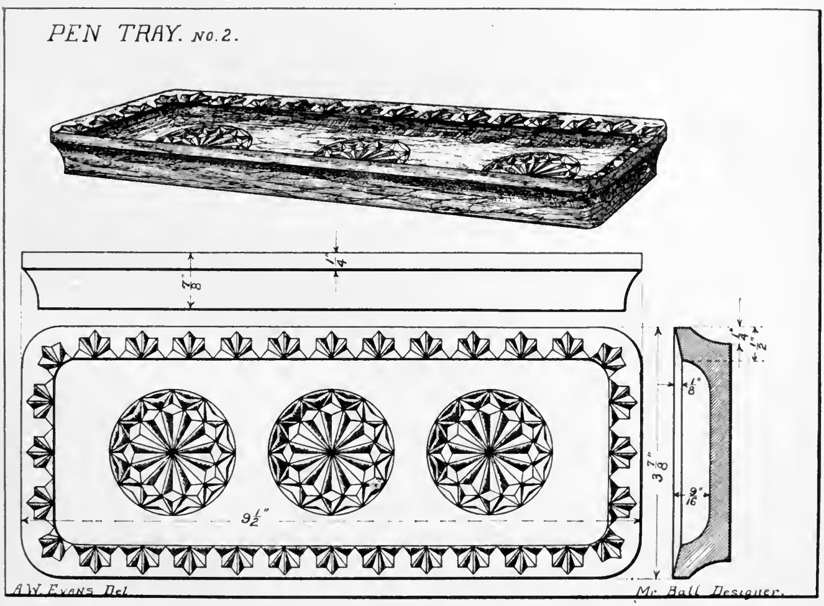
Stock, 1" x 2" x 12" rough Pine, 1" x 3" x 12" rough Gum, or a greater variety and a larger number of pieces.

1. Plane one face and one edge of pine board.
2. Gauge and saw off one ½" strip and plane to gauge line.
3. Plane one face and one edge of Gumwood board.
4. Gauge and saw off one ½" strip and plane to gauge line.
5. Glue together these two strips and proceed as above to prepare another strip which may then be glued on. The working faces should be held as evenly as possible in gluing and should all be on one side.
6. When all five or more strips are glued the face side should be carefully leveled with the smoothing-plane, the thickness gauged and the opposite face (which is still unplaned) planed to gauge lines.
7. Draw center line and mark curves.
8. Gauge sides of groove.

9. Gouge curves as shown (do not use mallet or hammer on gouge.)
10. Scrape with swan-neck scraper.
11. Gauge and plane chamfer.
12. Clean and shellac.

NOTE.—Test semicircle with trysquare as shown in sketch above.

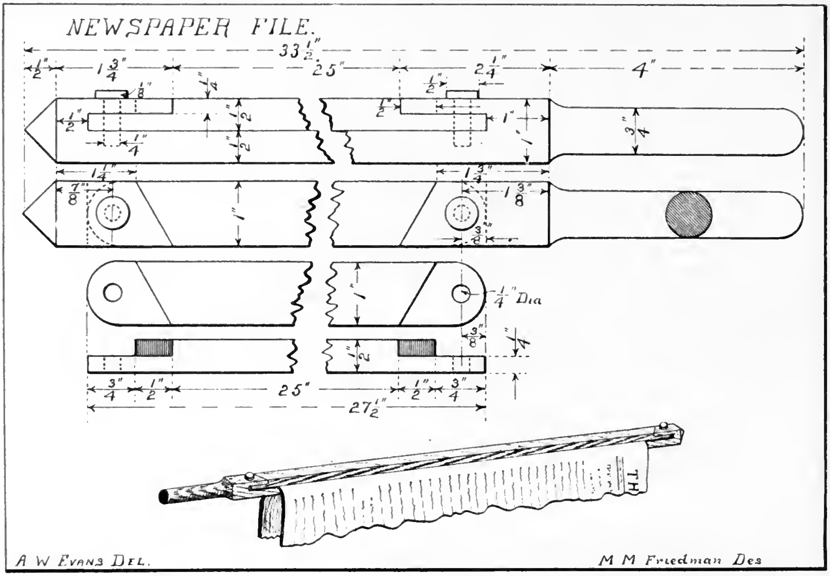
DRAWING.—No drawing is required but may be made if the teacher decides that it is best.

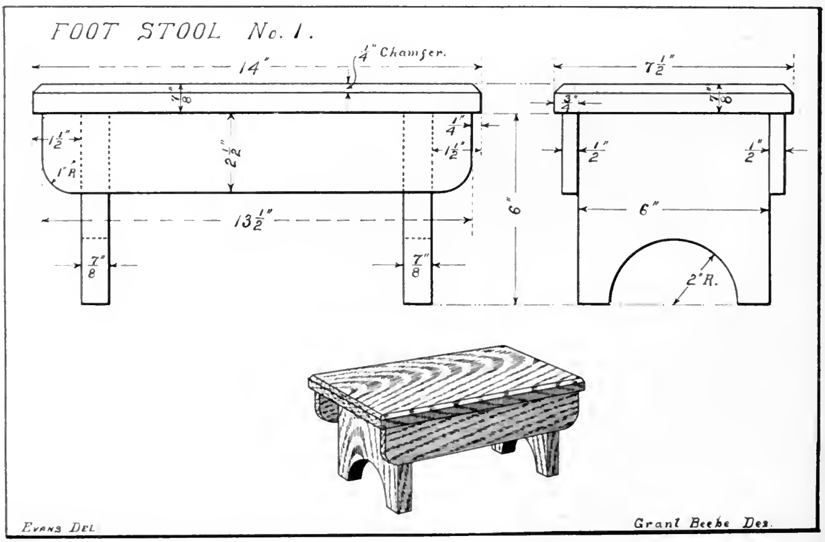


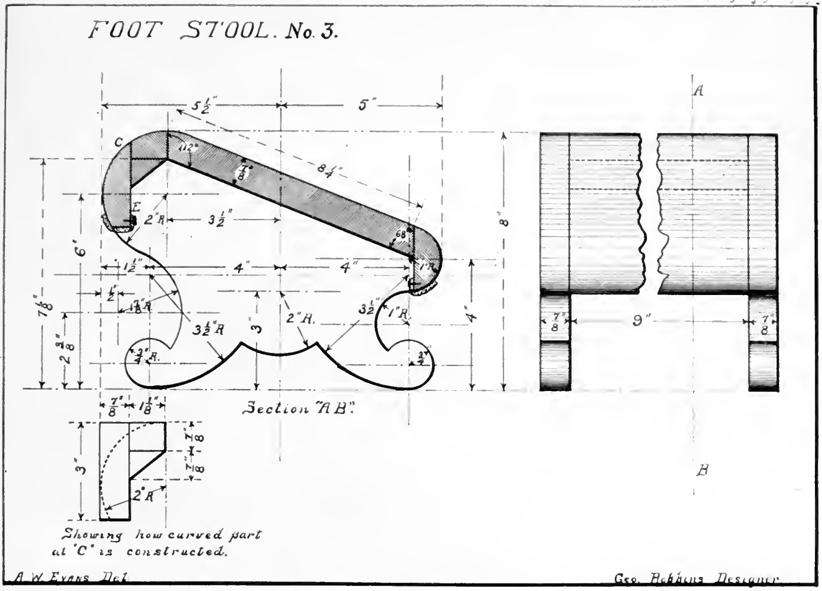
PEN TRAY No. 2.

Stock, 7/8", s. 2 s., Gum.

All gouge work is to be left rough showing the marks of the gouge.


NEWSPAPER FILE.
A W Evans Del.
M M Friedman Des


FOOT STOOL No. 1.
1/4" Chamfer.
Evans Del
Grant Beebe Des.



FOOT STOOL No. 3.

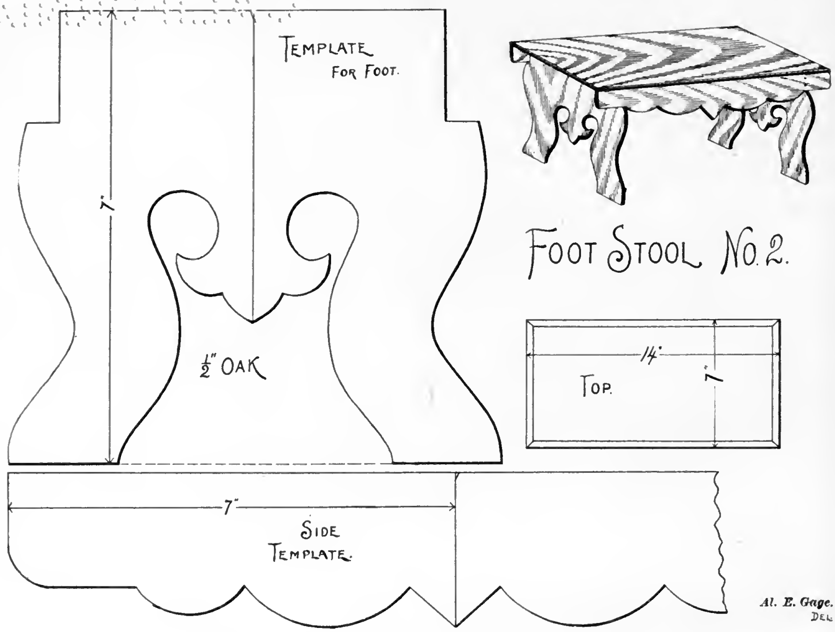
Stock, ⅞″, s. 2 s., Pine.

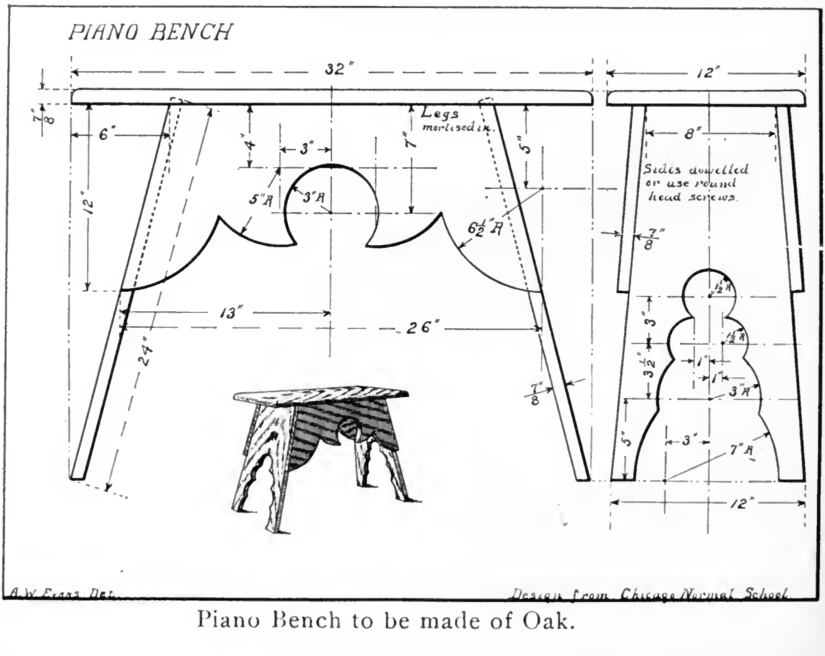
The curved outlines of the sides are to be sawed with a turning-saw, and finished with file and sandpaper. Each side is to be made separately, that is, one side is not to be used as a template in laying out the other side. This rule in regard to duplication of parts should be insisted upon in all cases.

The bevel is to be used in planing the edges of the top board, 112° and 68° being the required angles.

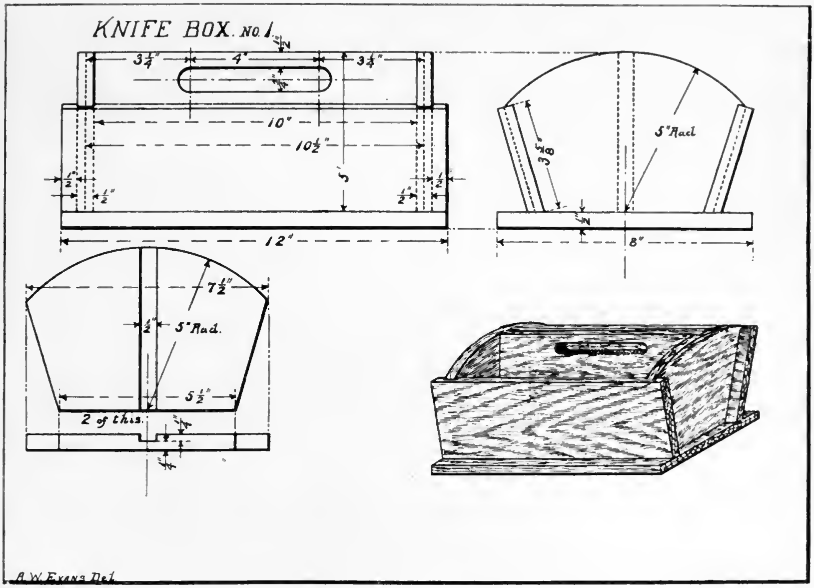
A cover of carpet may be supplied by the pupil.

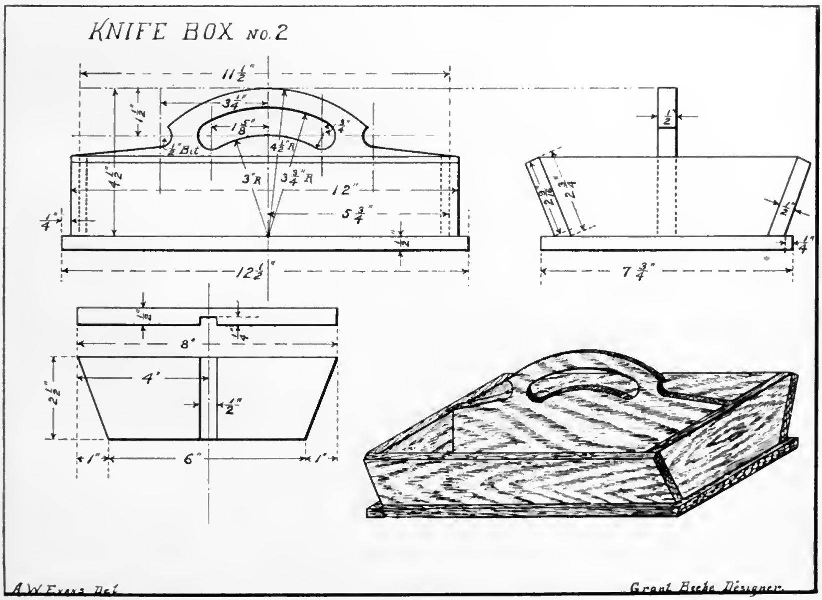
Drawing as shown, omitting shading.

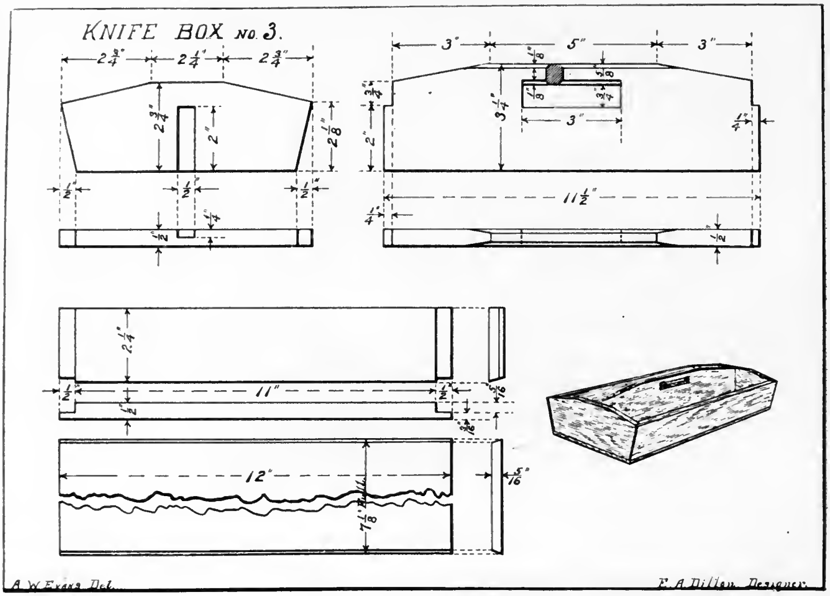




Piano Bench to be made of Oak.


KNIFE BOX. NO. 1.
A. W. Evans Del.


KNIFE BOX NO. 2
A. W. Evans Del.
Grant Beebe Designer.



KNIFE BOXES.

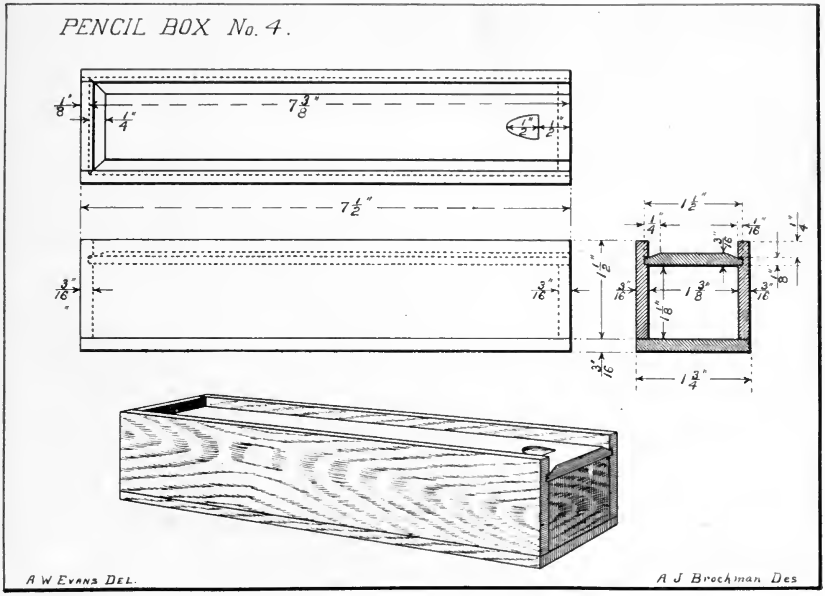
Stock, ½″, s. 2 s., Pine.

A choice is here given of three forms of knife boxes, all having in common the use of the bevel and all illustrating a rabbeted joint.

The intention is to have each pupil lay off his own work on a large ½″ board, instead of giving him stock cut approximately to size, this is to teach him economy in the use of material.

The teacher and not the pupil is to make the selection of the design to be used by the entire class.

Drawing—Detail drawings as shown (no perspective.)



PENCIL BOX No. 4.

Stock, $\frac{3}{16}''$ Bass, $9'' \times 9''$.

1. Plane edge and ends, making length $8\frac{1}{4}''$.
2. Mark gauge-lines for sides and bottom, allowing $\frac{1}{4}''$ between pieces for sawing and planing.
3. Saw off and plane to lines.
4. Make remaining piece $8\frac{1}{8}''$ long and cut off enough for cover.
5. Make front and back.
6. Mark gains on sides and back.
7. Cut gains with back or rip-saw, using a block clamped in position as guide for saw.
8. Glue and nail together and clean with plane and sandpaper.

NOTE.—Cover and sides may be ornamented with chip-carving before putting together.

DIMENSIONS OF PARTS.

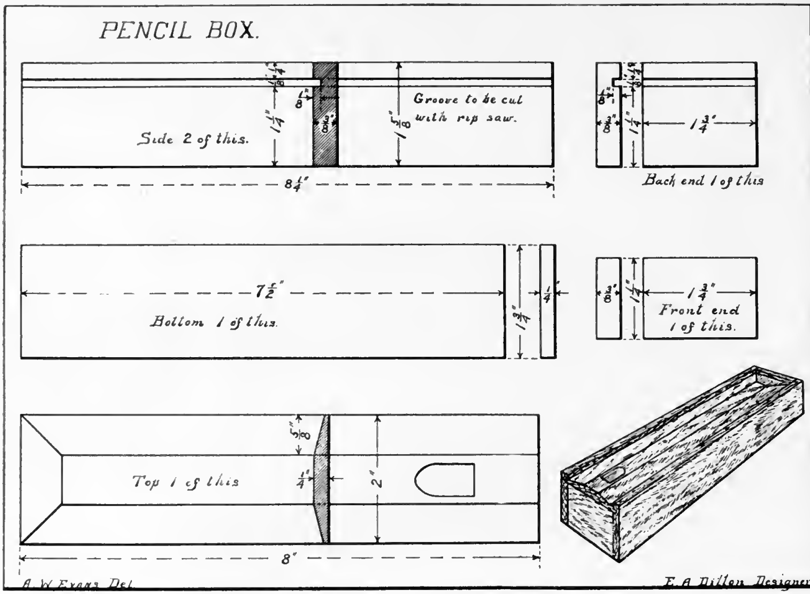
Sides, $\frac{3}{16}'' \times 1\frac{5}{8}'' \times 8\frac{1}{4}''$; Grooves, $\frac{1}{16}''$ wide and deep $\frac{3}{16}''$ from top.

Bottom, $\frac{3}{16}'' \times 1\frac{3}{4}'' \times 8\frac{1}{4}''$.

Back, $\frac{3}{16}'' \times 1\frac{5}{8}'' \times 1\frac{3}{8}''$; Grooves same as for sides.

Front, $\frac{3}{16}'' \times 1\frac{3}{8}'' \times 1\frac{3}{8}''$.

Cover, $\frac{3}{16}'' \times 1\frac{1}{2}'' \times 8\frac{1}{8}''$.

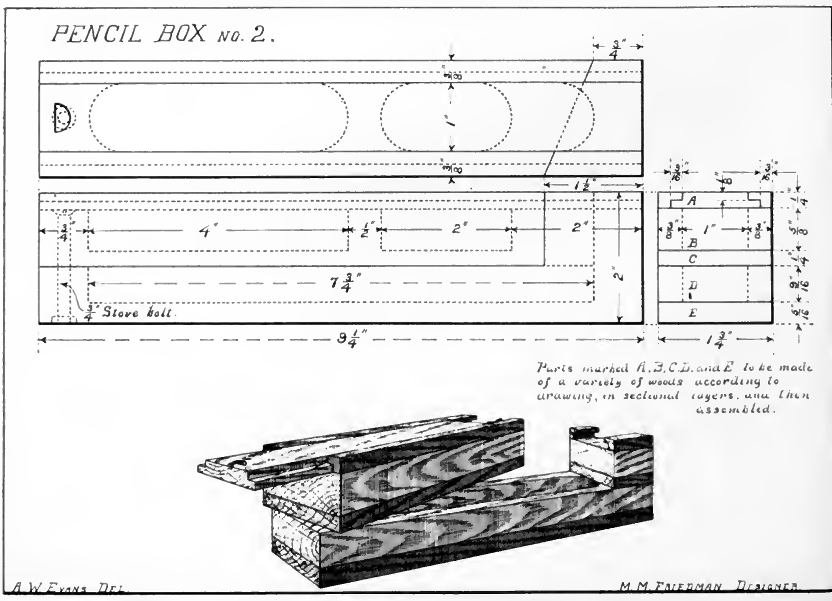


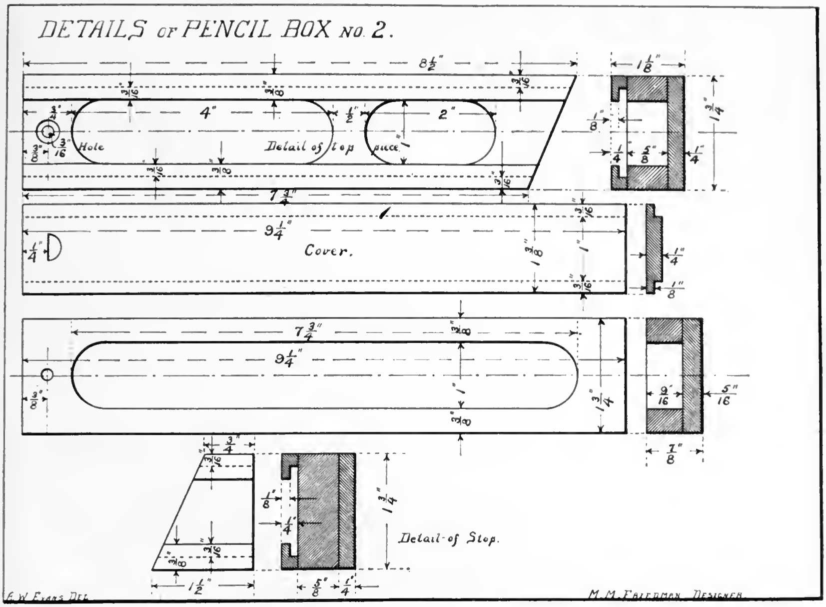
PENCIL BOX No. 1.

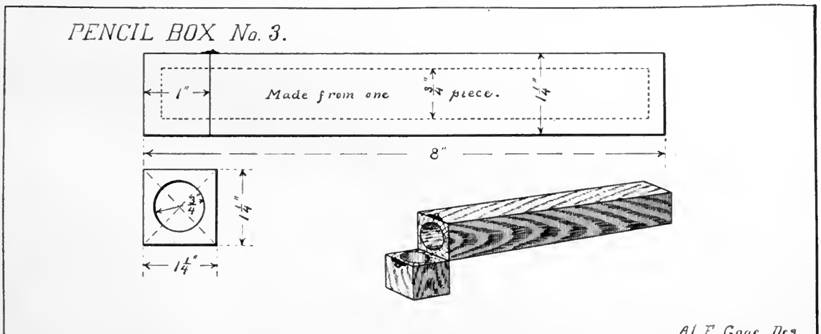
Stock, 3/8″, s. 2 s., Pine or Whitewood.

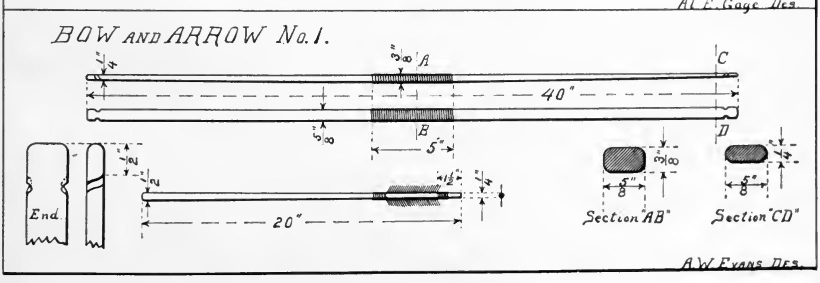
The teacher will prepare the necessary directions for work. The 1/4″ pieces are to be planed to required thickness from the 3/8″ stock.

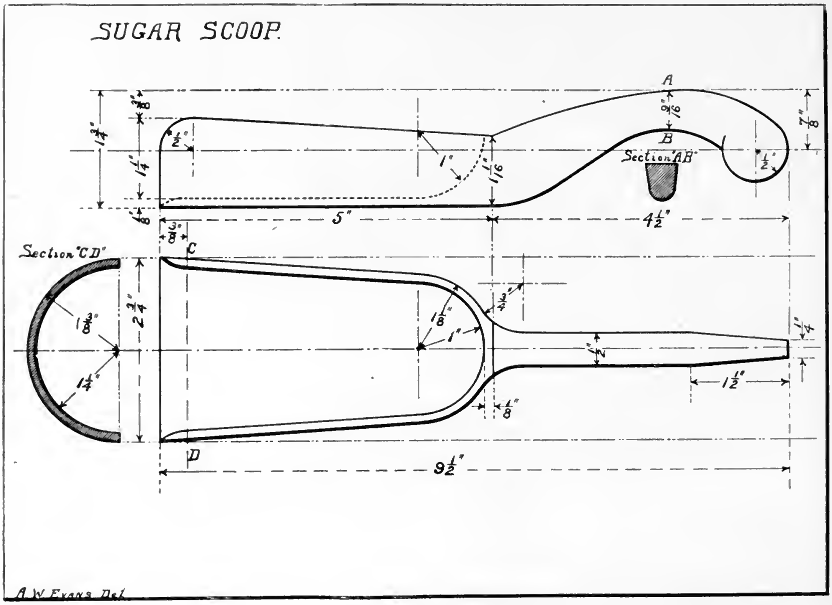
Drawing—Same as above, omitting perspective.




DETAILS OF PENCIL BOX No. 2.
Hole
Detail of Stop piece
Cover.
Detail of Stop.
A. W. Evans Del.
M. M. Friedman, Designer


PENCIL BOX No. 3.
Made from one 3/4" piece.
Al E. Gage Des.


BOW AND ARROW No. 1.
End.
Section "AB"
Section "CD"
A. W. Evans Des.



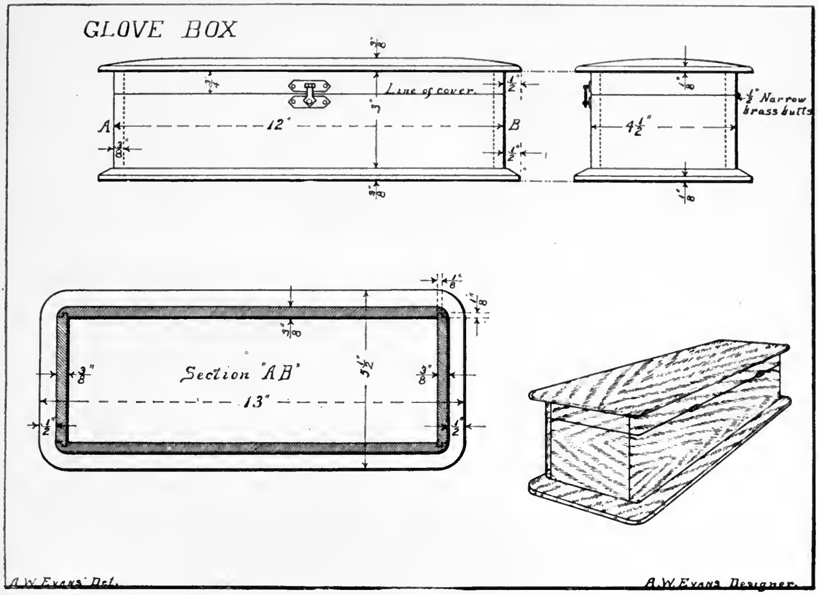
SUGAR SCOOP.

Stock, 2″ x 3″ x 10″, s. 4 s., Birch, or several varieties of wood glued together.

1. Draw side elevation on 2″ face of block and saw nearly to lines.
2. Draw plan on 3″ or top face of block and saw nearly to lines of handle leaving sides of scoop parallel until after gouging is finished.
3. Gouge inside of scoop and finish with scraper.
4. Complete sawing nearly to lines of top view.
5. The remainder of this exercise is to be done free-hand, using the gouge, knife, spokeshave, file and scraper.
6. Remove all tool marks with sandpaper and finish with shellac.

NOTE.—Great care should be used in forming the curves which join the handle and scoop as the tendency is to make them too abrupt.

Drawing—The drawing of this exercise is optional with the teacher.

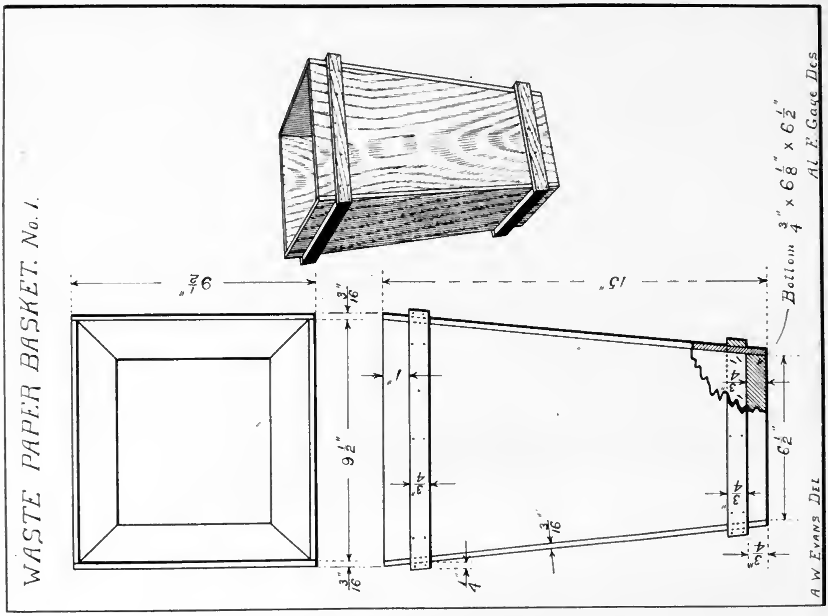


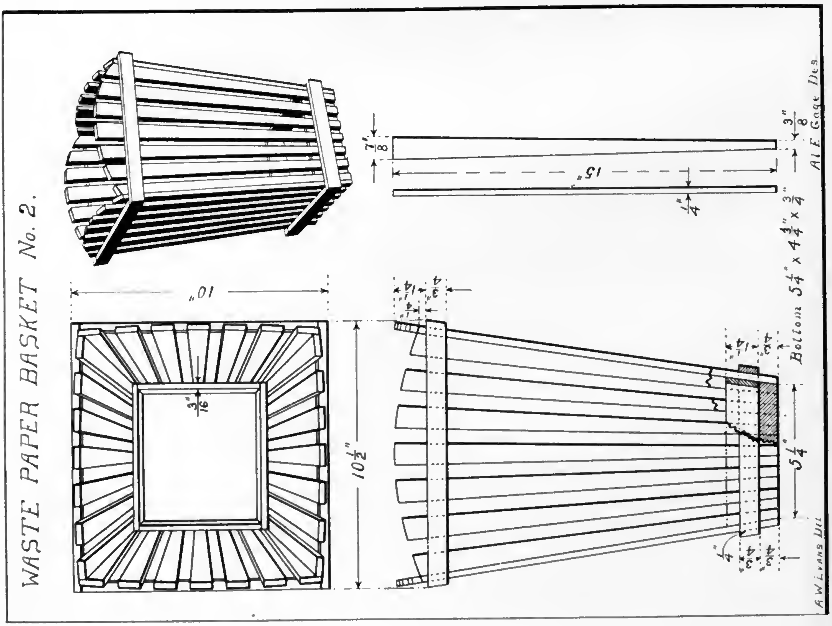
GLOVE BOX.

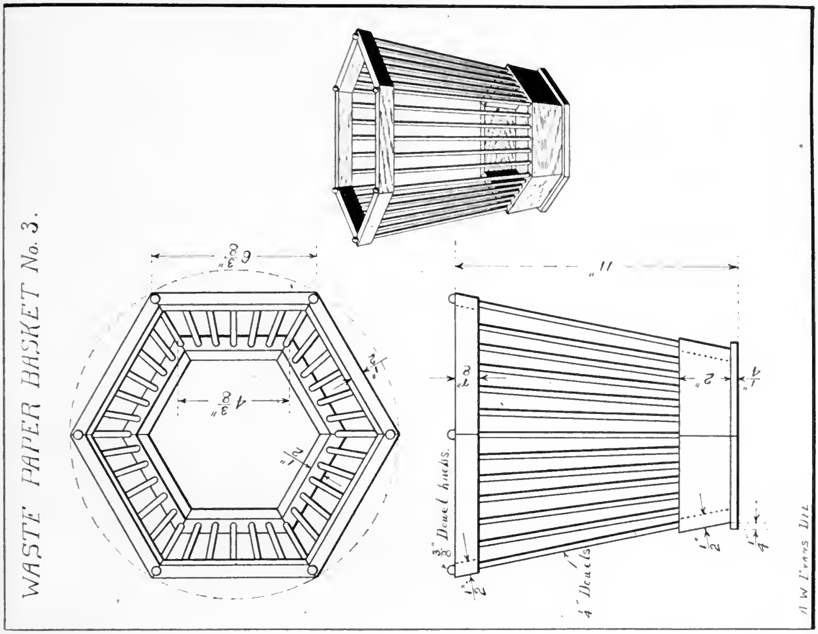
Stock, ⅜″ Oak, or other Hardwood.

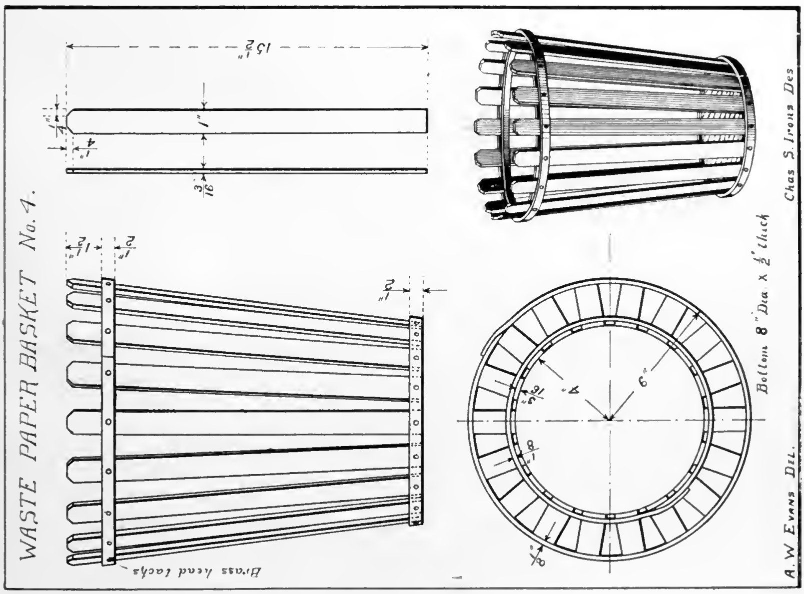
1. Prepare stock for sides and ends in the usual way.
2. Mark gains and cut out with back-saw, using a block with straight edge clamped in position, as a guide for saw.
3. Fit ends to sides and glue together, being careful that box is square.
4. Prepare top and base, leaving top flat but planing beveled edges on base.
5. True edges and sides of box, and mark gauge-lines for cover ¾″ and ⅞″ from one edge of box.
6. Glue top and base in position (½″ brads placed on inside of top and base along inner line of box will make it possible to locate them readily after glue has been applied).
7. Plane top to shape and clean box with scraper and sandpaper.
8. Fill, and finish with four or five coats of shellac and rub down with pumice-stone and water.
9. Saw between gauge lines on sides of box and plane to lines. Fit hinges and catch. Line with colored silk or satin if desired.

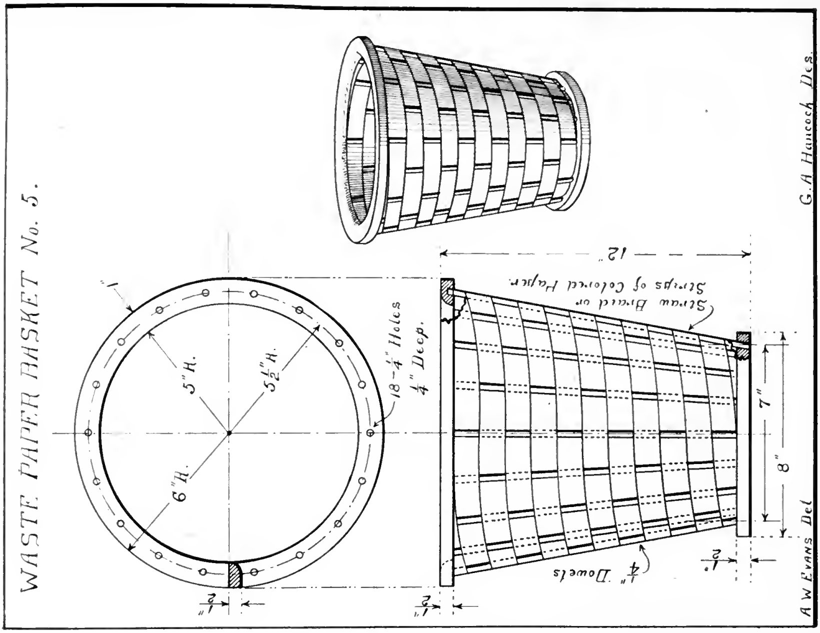
General Drawing and section.

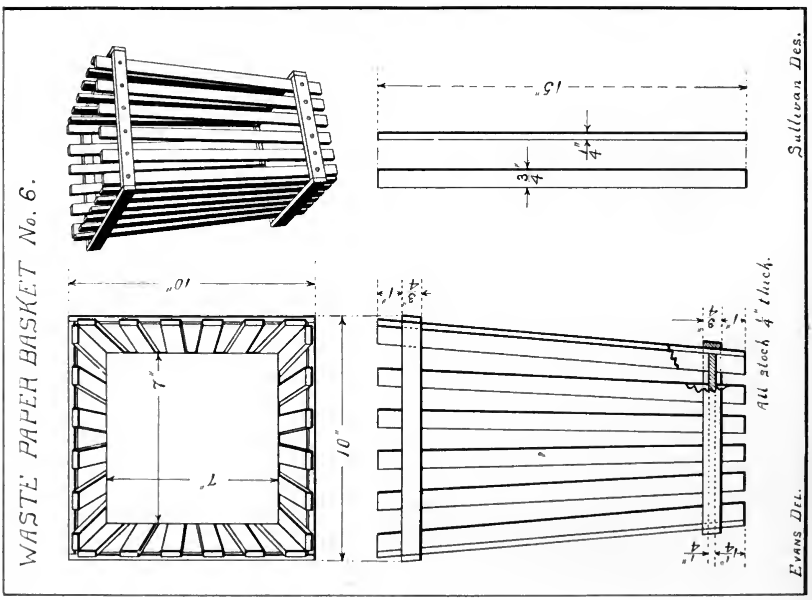

WASTE PAPER BASKET. No. 1.
Bottom $\frac{3}{4}$" x $6\frac{1}{8}$" x $6\frac{1}{2}$"
A W Evans Del
Al E Gage Des

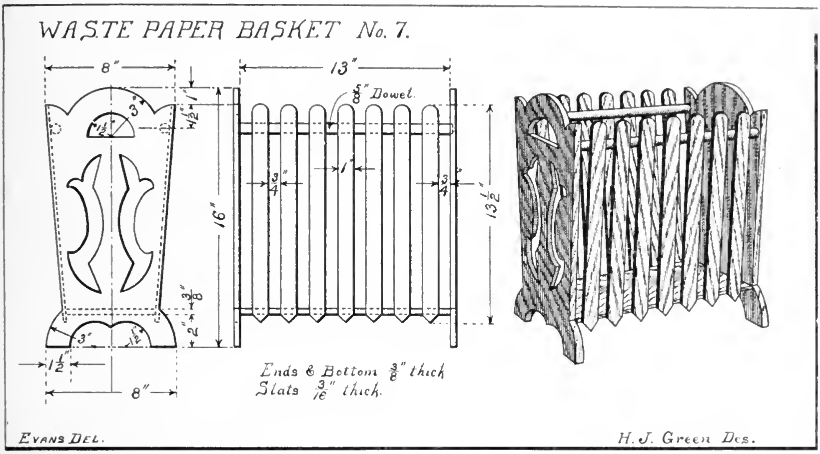

WASTE PAPER BASKET No. 2.
Bottom $5\frac{1}{4}$" x $4\frac{1}{4}$" x $\frac{3}{4}$"
A W Evans Del
Al E Gage Des

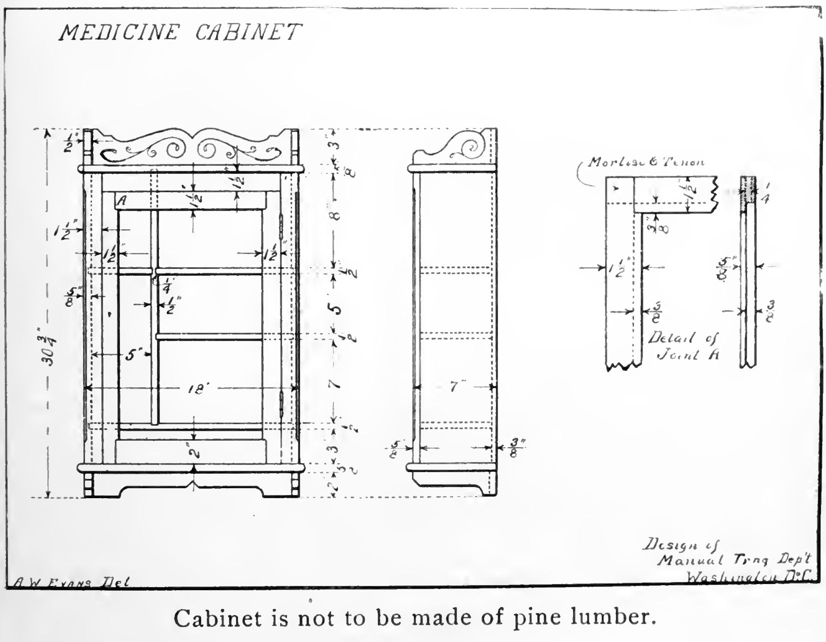

WASTE PAPER BASKET No. 3.
6 3/8"
4 3/8"
1/2"
1/2"
11"
7/8"
2"
1/4"
3/8" Dowel knobs.
1/4" Dowels
1/2"
1/2"
1/4"
A W Evans Del


WASTE PAPER BASKET No. 4.
15 1/2"
1"
1/4"
1/4"
3/16
1/2"
1 1/2"
1/2"
Brass head tacks
Bottom 8" Dia x 1/2" thick
6"
4"
3/16
1/8
5/8"
Chas S. Irons Des
A. W Evans Del.


WASTE PAPER BASKET No. 5.
18-1/4" Holes 1/4" Deep.
Straw Braid or Strips of Colored Paper
1/4" Dowels
A W Evans Del
G.A Hancock Des.

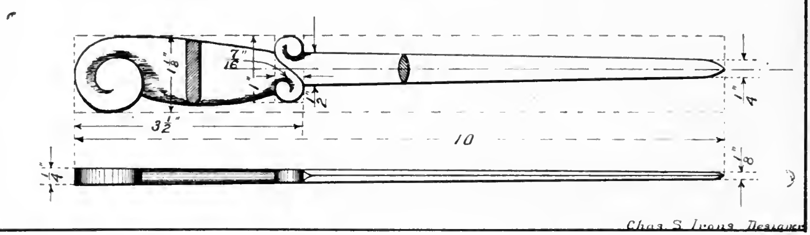

WASTE PAPER BASKET No. 6.
All stock 1/4" thick.
Evans Del.
Sullivan Des.



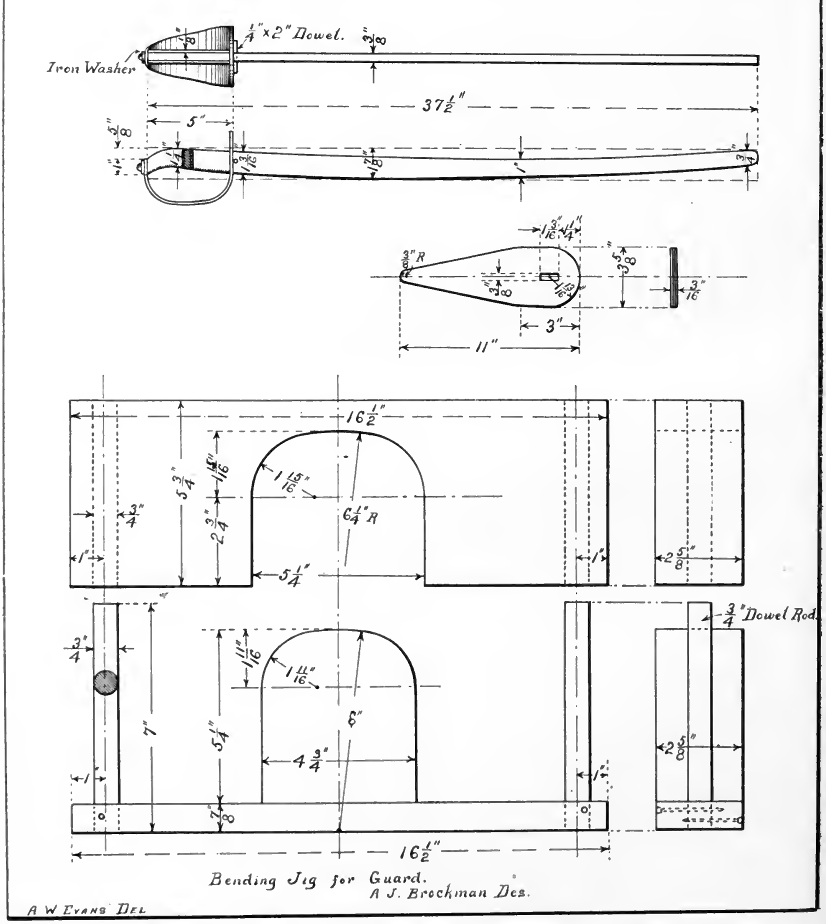


Cabinet is not to be made of pine lumber.

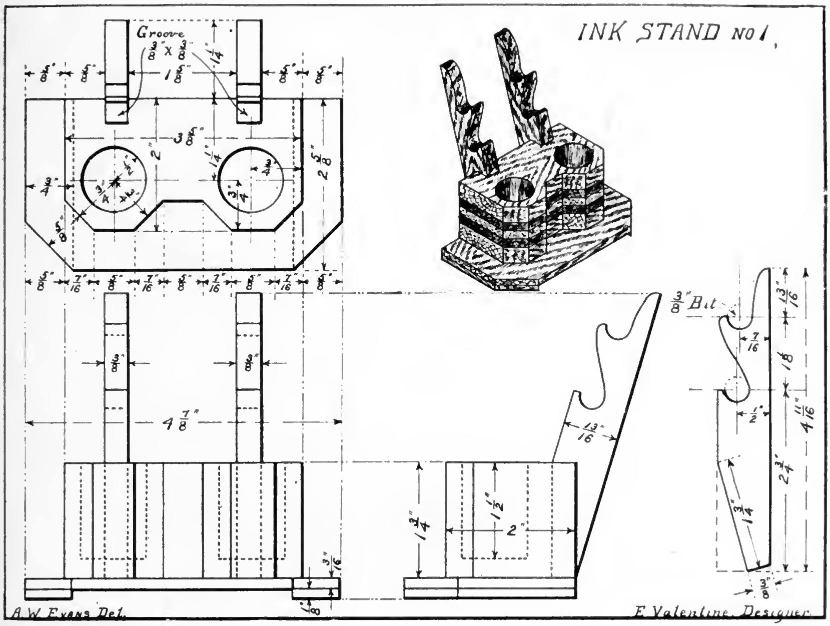
LETTER OPENER No. 3

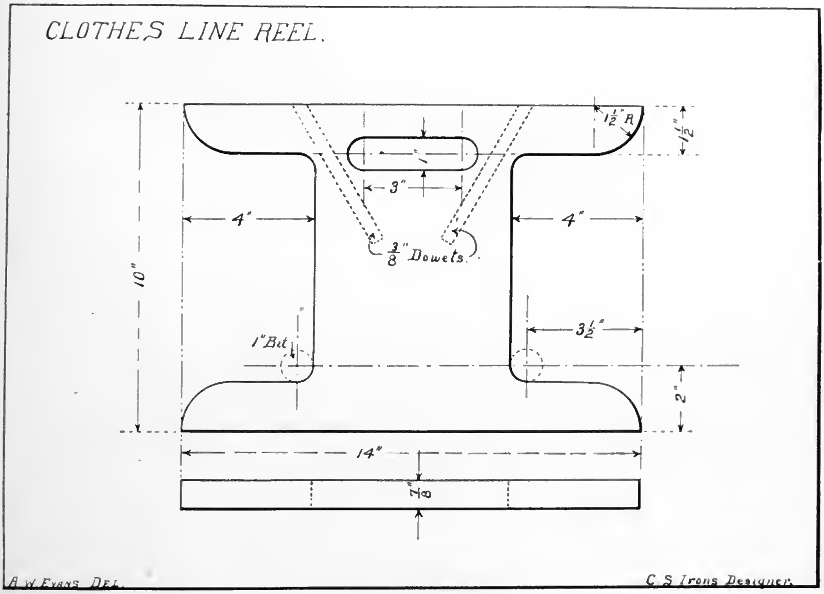


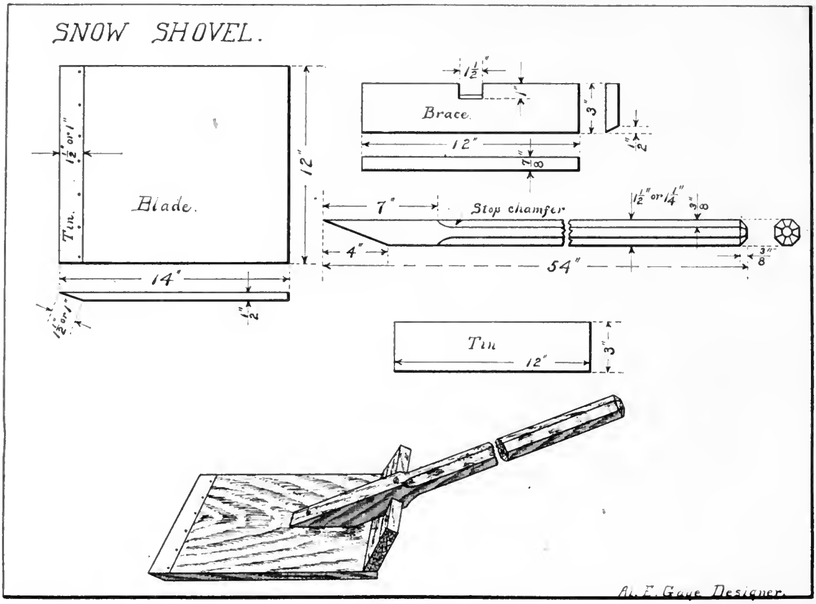
FENCING SABER No. 1.

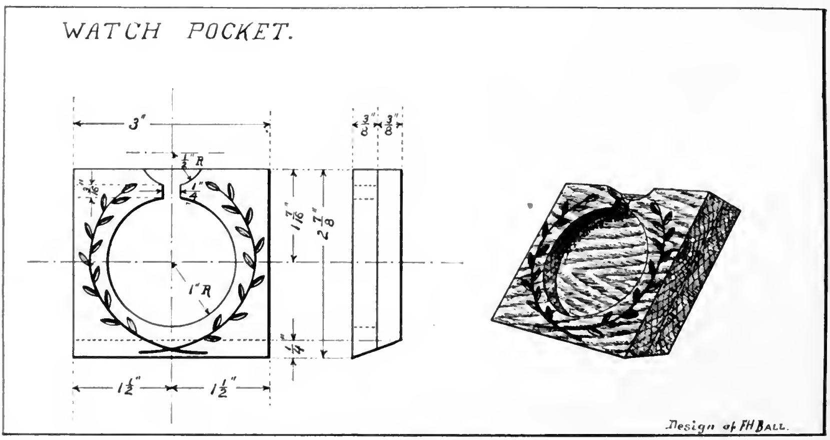


Neither Letter Opener or Saber is to be made of pine lumber.

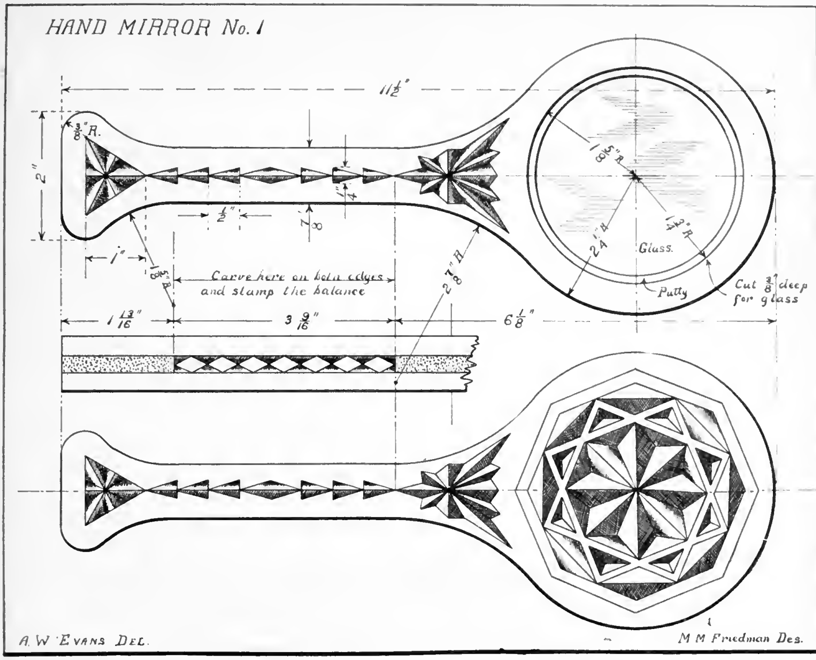

INK STAND NO 1.
Groove
3/8" x 3/8"
3/8" Bit
A. W. Evans Del.
E. Valentine, Designer.

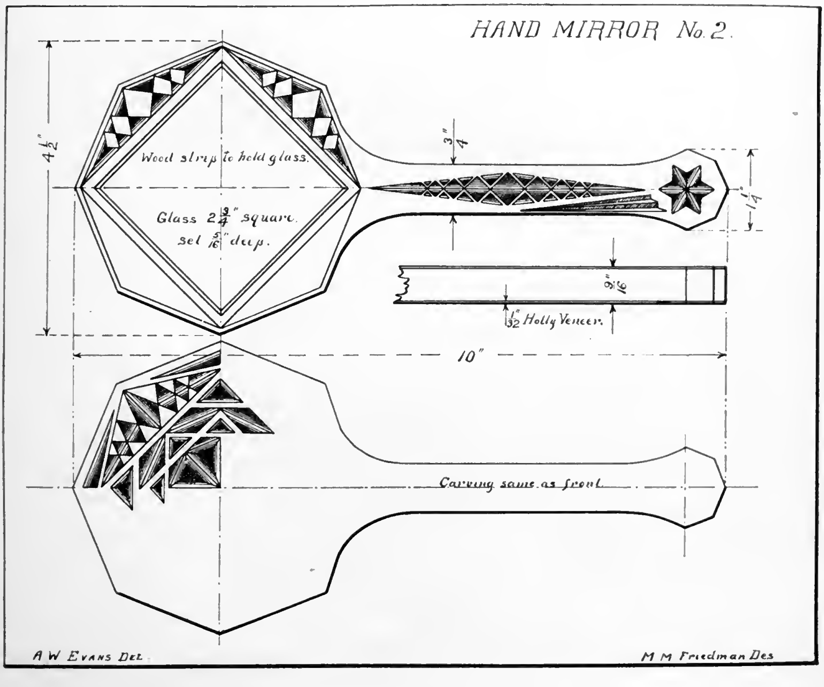

CLOTHES LINE REEL.
1 1/2" R
3/8" Dowels.
1" Bit
A. W. Evans Del.
C. S. Irons Designer.

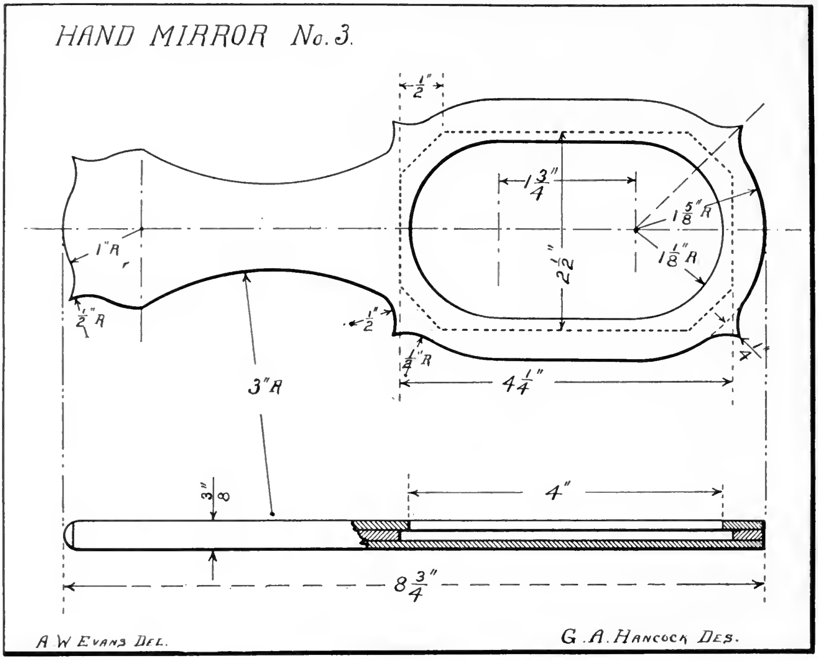




Not to be made of pine lumber.


HAND MIRROR No. 1
11 1/2"
2"
3/8" R.
1/2"
7/8"
1/4"
1"
1 5/8" R
Carve here on both edges
and stamp the balance
2 7/8" R
1 13/16"
3 9/16"
6 1/8"
2 1/4" R
1 3/4" R
Glass.
Putty
Cut 3/8 deep
for glass
A. W. Evans Del.
M M Friedman Des.


HAND MIRROR No. 2.
4 1/2"
Wood strip to hold glass.
Glass 2 3/4" square.
set 5/16" deep.
3/4"
1 1/4"
9/16"
1/32" Holly Veneer.
10"
Carving same as front.
A W Evans Del.
M M Friedman Des

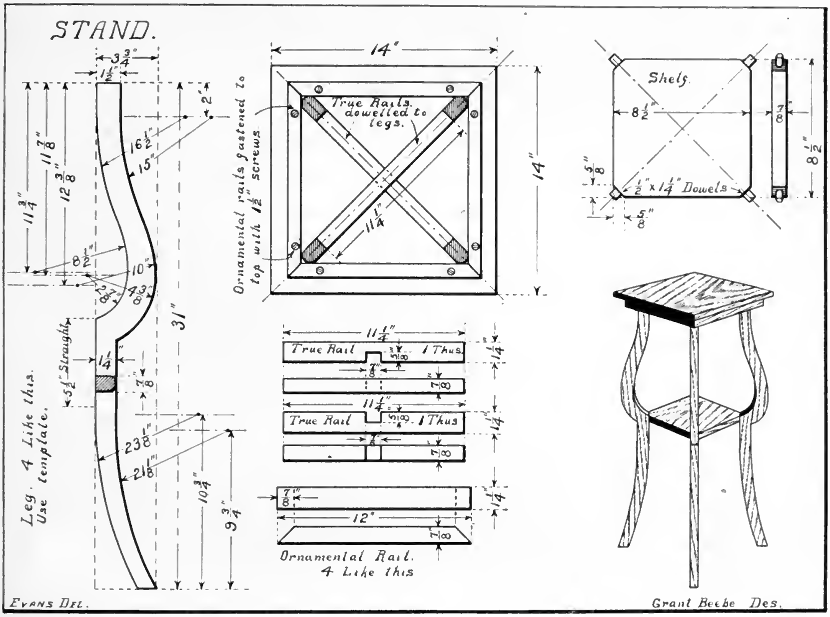


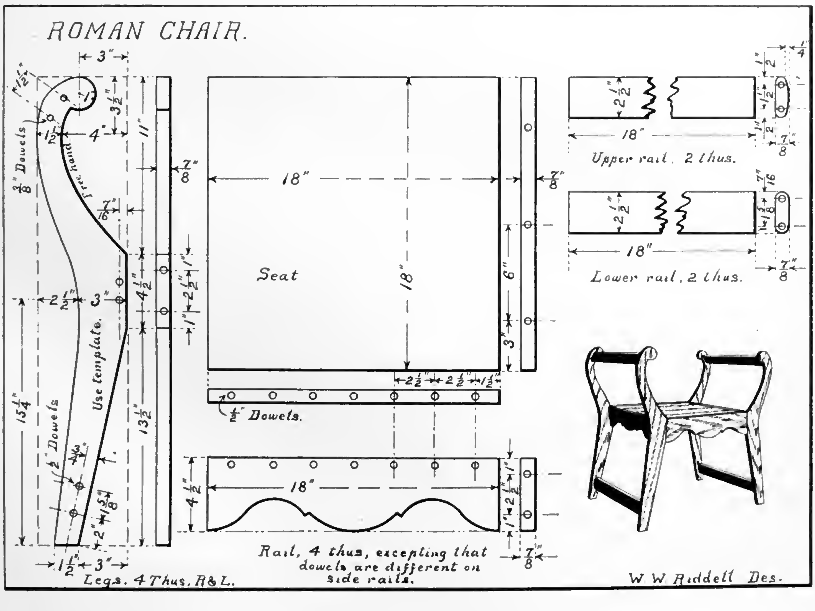
HAND MIRROR No. 3.

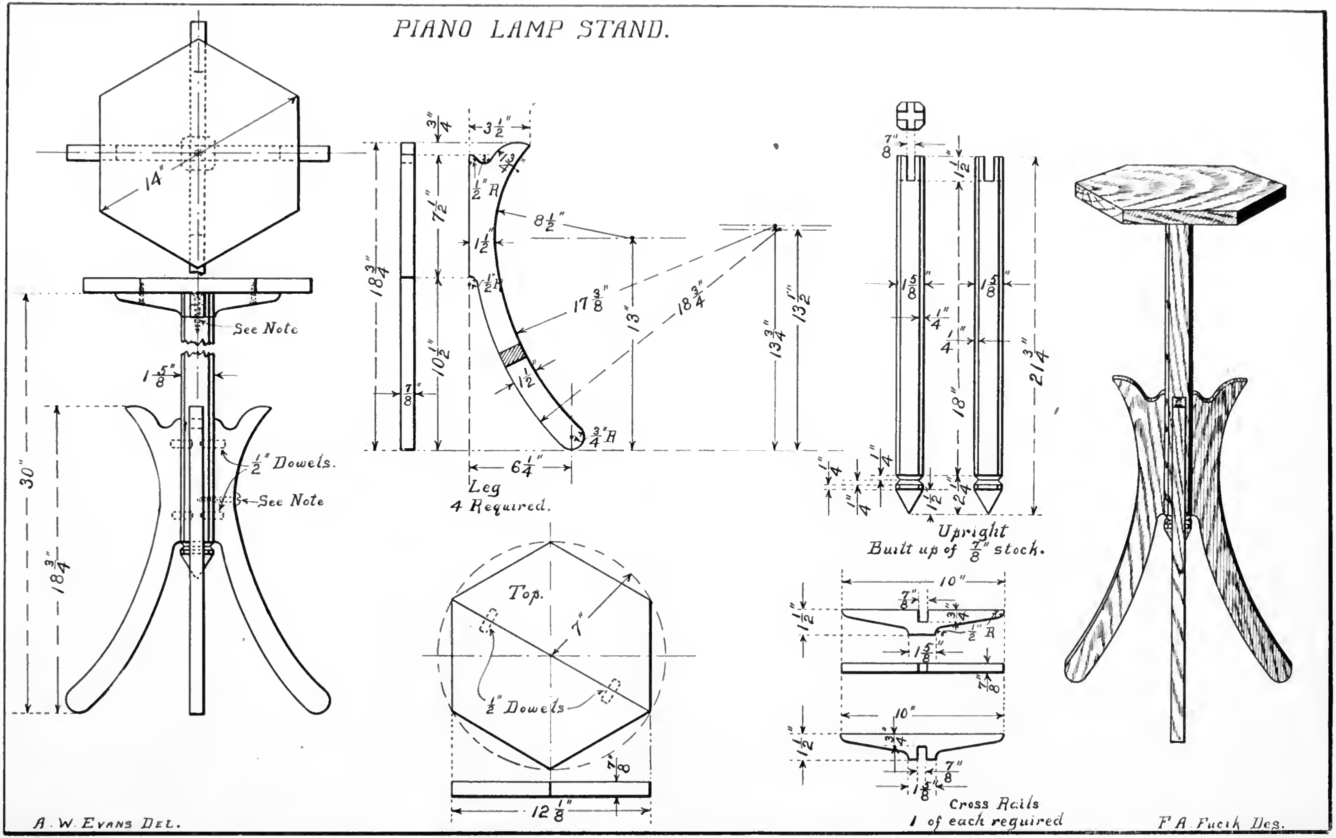
Stock, three pieces of 1/8" Basswood.

The back is to be left solid. The front is to have an opening as shown. The glass to be 4 1/4" x 2 1/2", with 1/2" taken off from each corner.

This is an exercise in the use of the coping-saw, and in gluing. The handle may be rounded if desired.

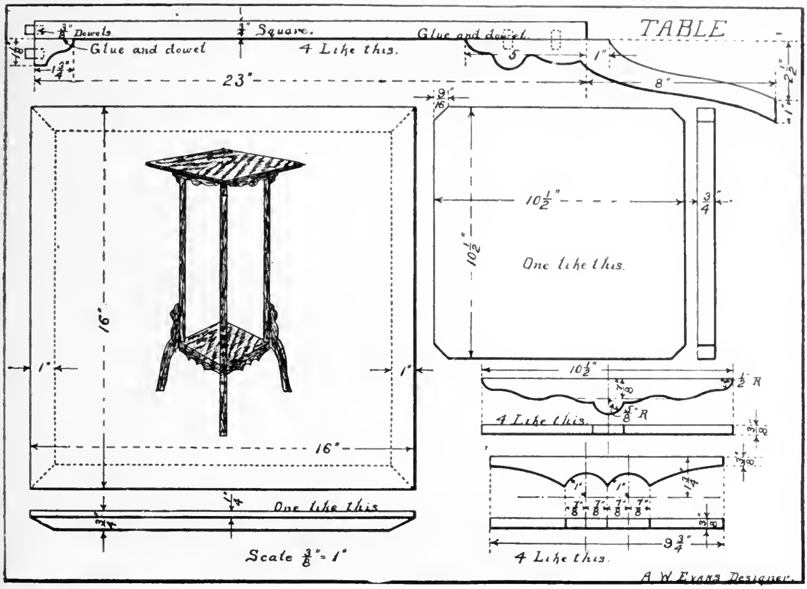

STAND.
Leg. 4 Like this. Use template.
$5\frac{1}{2}$" Straight
Ornamental rails fastened to top with $1\frac{1}{2}$" screws
True Rails dowelled to legs.
Shelf.
$\frac{1}{2}$" x $1\frac{1}{4}$" Dowels
True Rail 1 Thus
True Rail 1 Thus
Ornamental Rail. 4 Like this
Evans Del.
Grant Beebe Des.

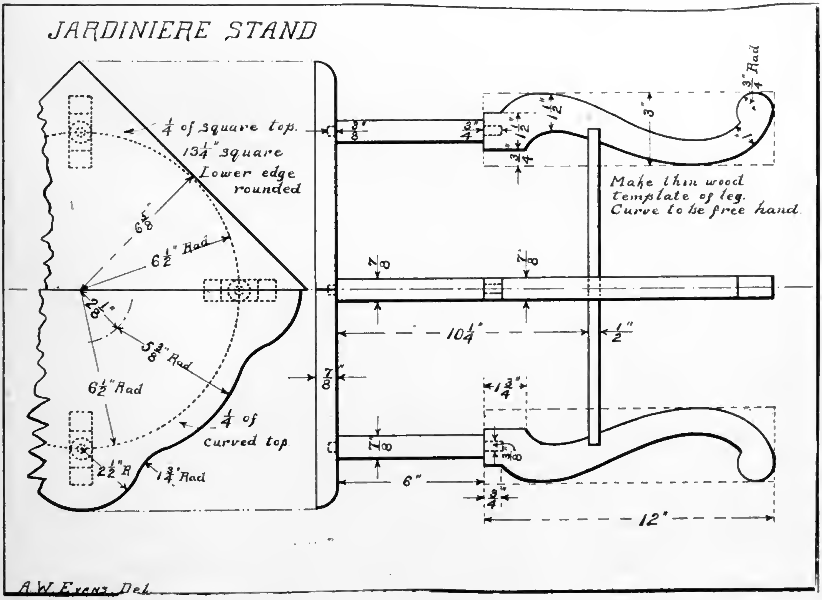

ROMAN CHAIR.
$\frac{3}{8}$" Dowels
Free hand
Use template.
$\frac{1}{2}$" Dowels
Legs. 4 Thus. R&L.
Seat
$\frac{1}{2}$" Dowels.
Upper rail. 2 thus.
Lower rail, 2 thus.
Rail, 4 thus, excepting that dowels are different on side rails.
W W Riddell Des.



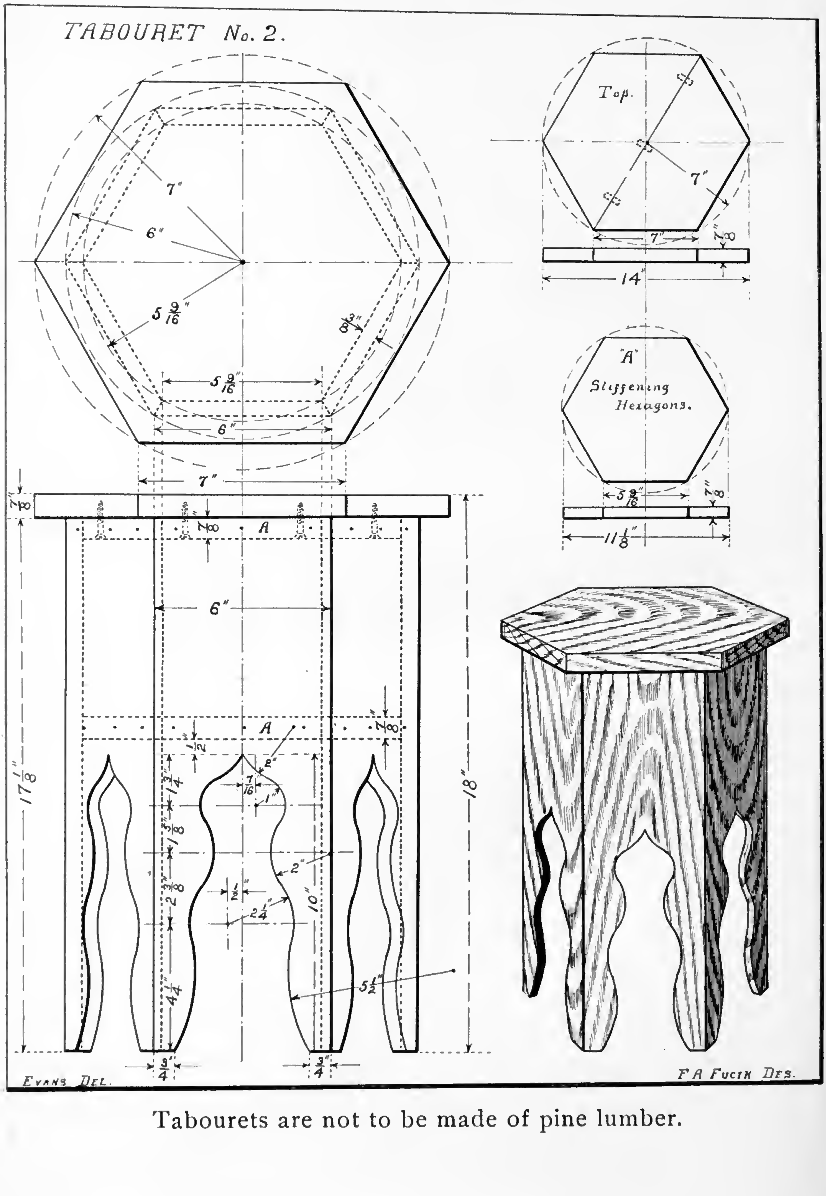
PIANO LAMP STAND.

NOTE.—Cross-rails to be glued and nailed in position to upright before top is put on. Top to be fastened as shown; either square, round or hexagonal top can be used as desired. Legs can be fastened with round headed screws instead of dowels.

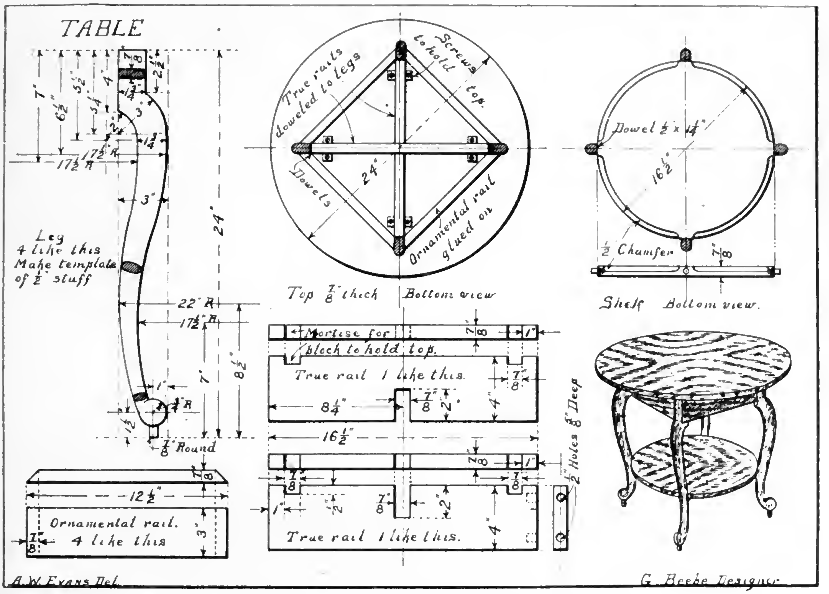




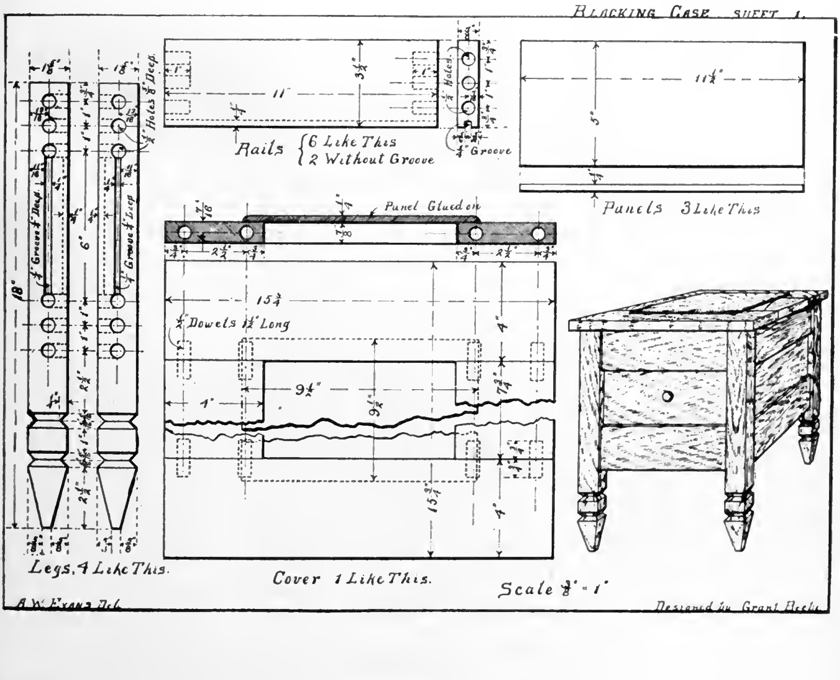
Tables and Stands are to be made of pine lumber.

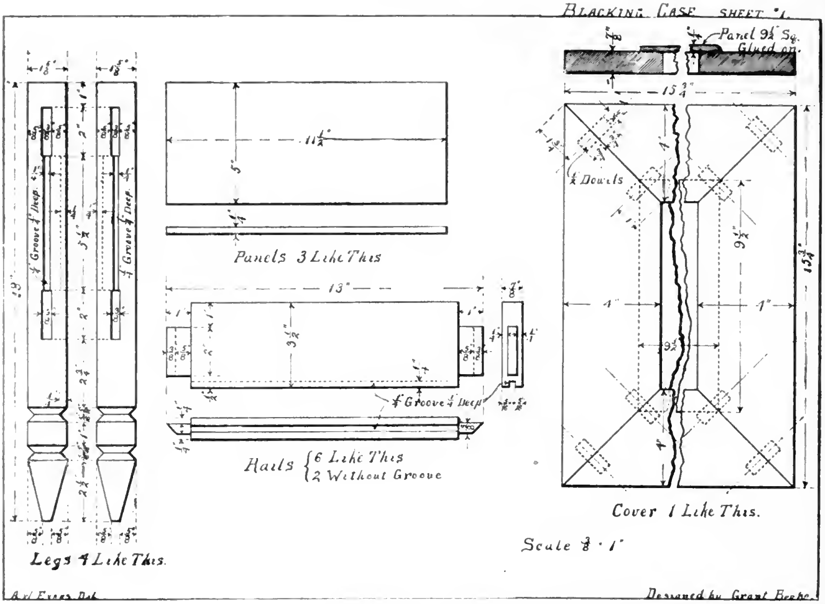


Tabourets are not to be made of pine lumber.

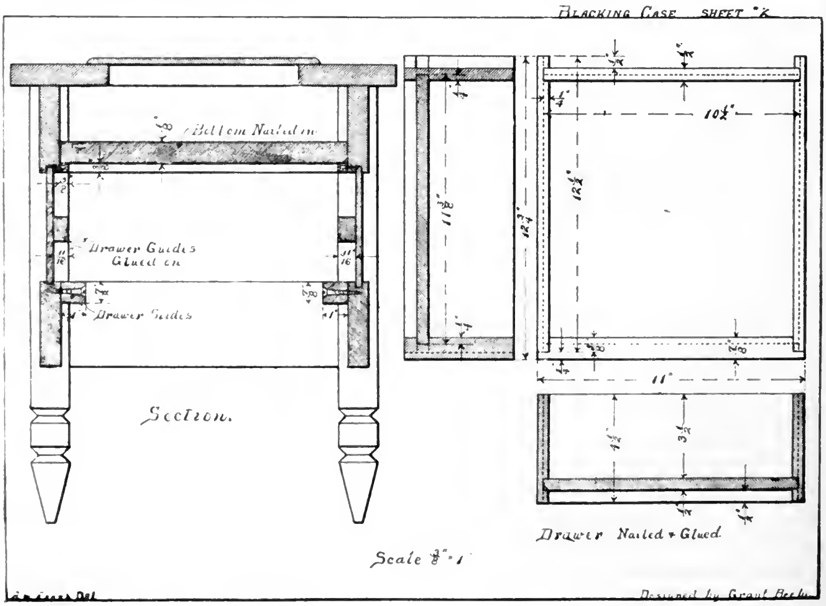


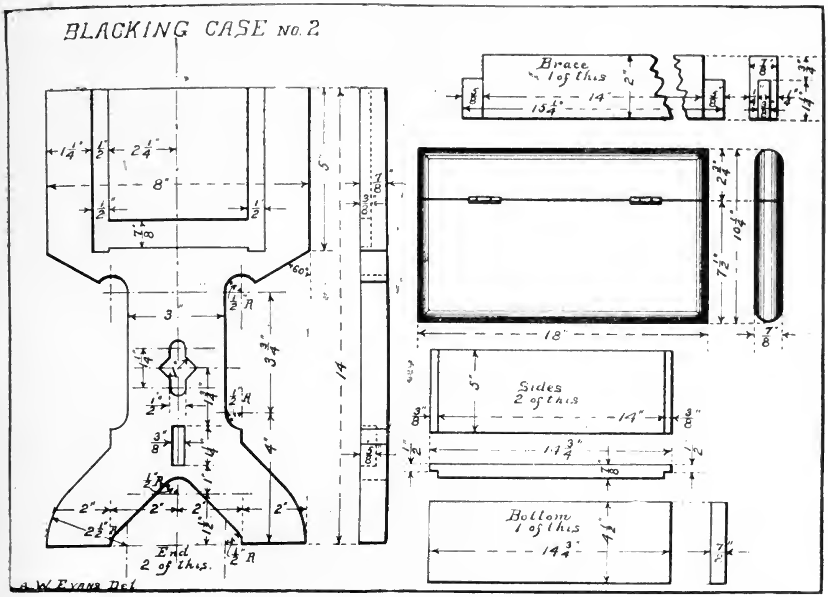
Use hardwood in making this Table.

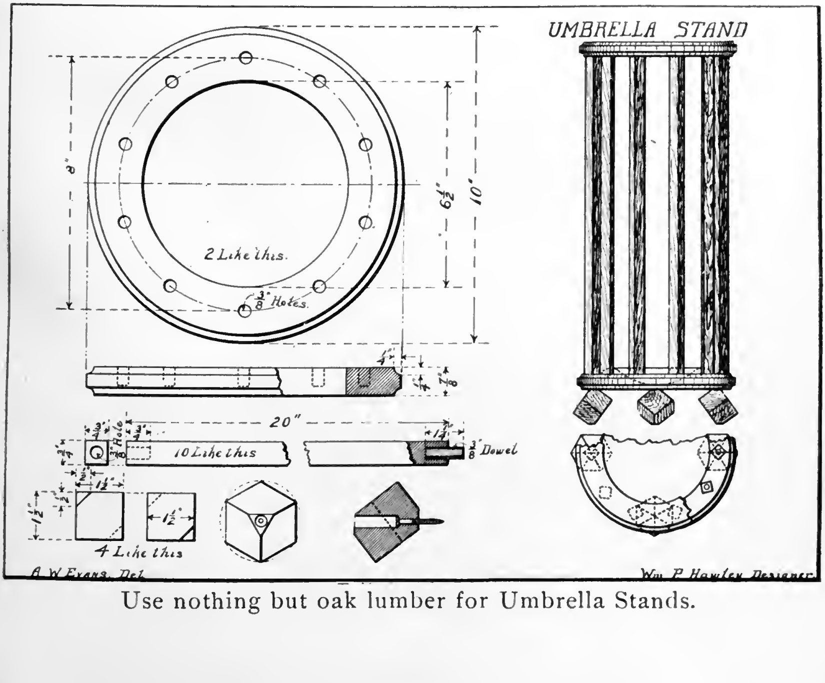




This form is more difficult of construction than that shown on previous page. Sheet No. 2 applies to both drawings.





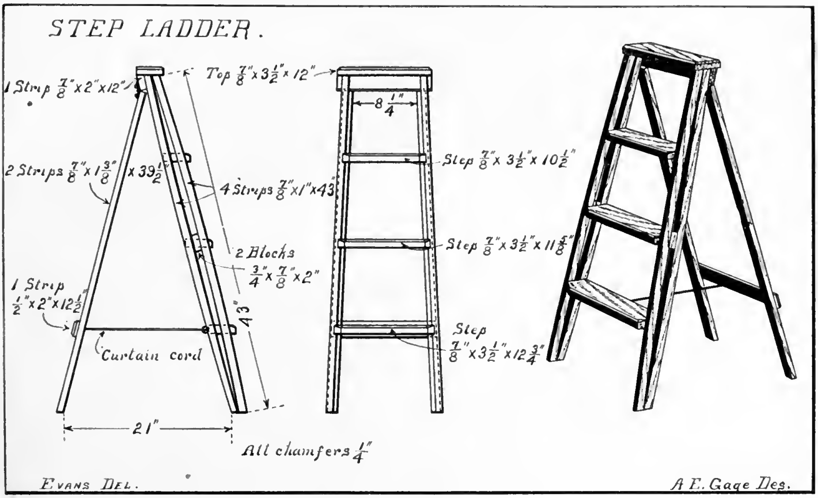


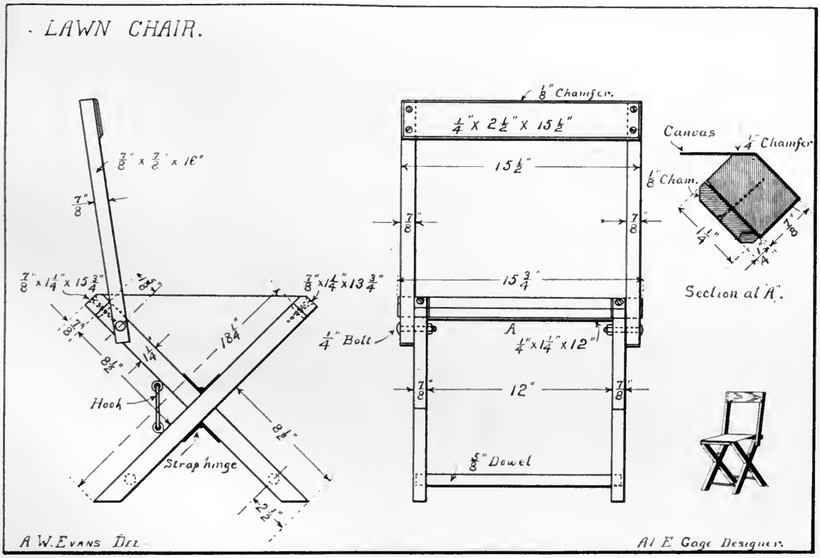
Use nothing but oak lumber for Umbrella Stands.

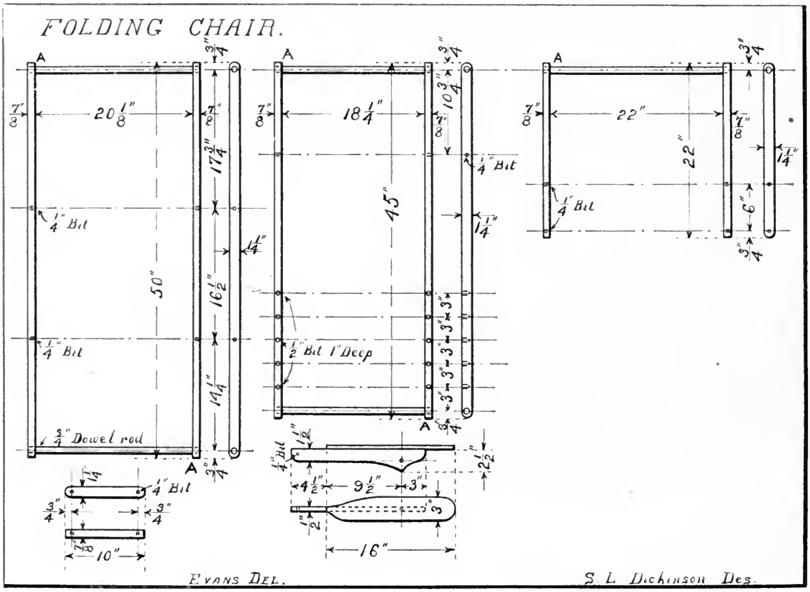
Step Ladder.

Al. E. Gage.
Designer.

Height = 3' 6"
Top Step = $10\frac{1}{2}$"
Bottom Step = $12\frac{1}{2}$"
Side Strips = 1" X $\frac{7}{8}$" X $3\frac{1}{2}$'


STEP LADDER.
1 Strip 7/8" x 2" x 12"
Top 7/8" x 3 1/2" x 12"
8 1/4"
2 Strips 7/8" x 1 3/8" x 39 1/2"
4 Strips 7/8" x 1" x 43"
Step 7/8" x 3 1/2" x 10 1/2"
2 Blocks 3/4" x 7/8" x 2"
Step 7/8" x 3 1/2" x 11 5/8"
1 Strip 1/2" x 2" x 12 1/2"
43"
Step 7/8" x 3 1/2" x 12 3/4"
Curtain cord
21"
All chamfers 1/4"
Evans Del.
A E. Gage Des.


LAWN CHAIR.
1/8" Chamfer.
1/4" x 2 1/2" x 15 1/2"
7/8" x 7/8" x 16"
Canvas
1/4" Chamfer
15 1/2"
1/8" Cham.
7/8"
7/8"
7/8"
1 1/4"
7/8"
1/4"
7/8" x 1 1/4" x 15 3/4"
7/8" x 1 1/4" x 13 3/4"
15 3/4"
Section at A.
1/4" Bolt
A
1/4" x 1 1/4" x 12"
18 1/4"
1 1/4
8 1/2"
7/8"
12"
7/8"
Hook
8 1/4"
5/8" Dowel
Strap hinge
2 1/2"
A W. Evans Del.
A E Gage Designer.

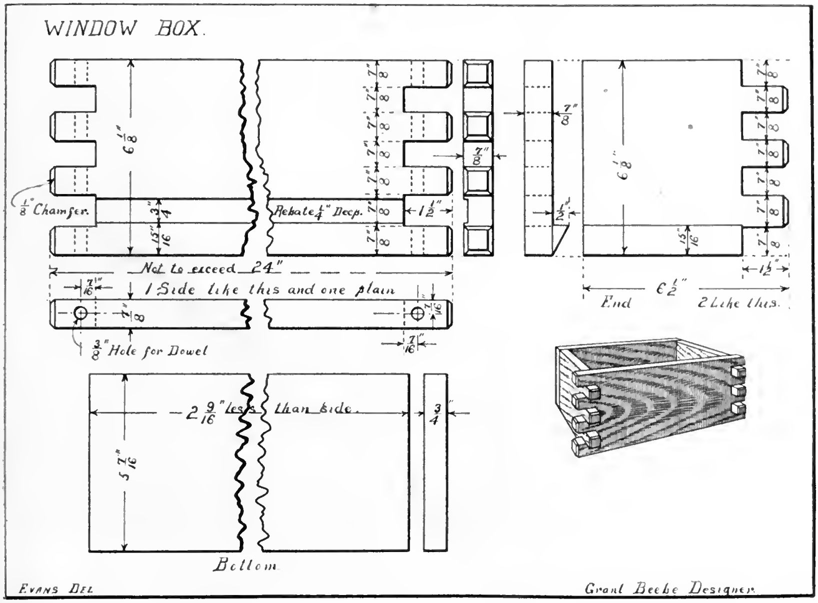


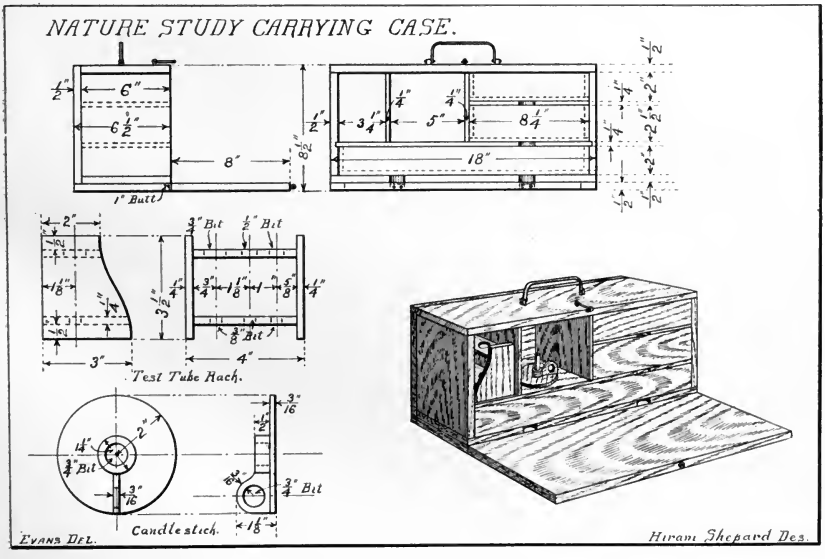
FOLDING CHAIR.

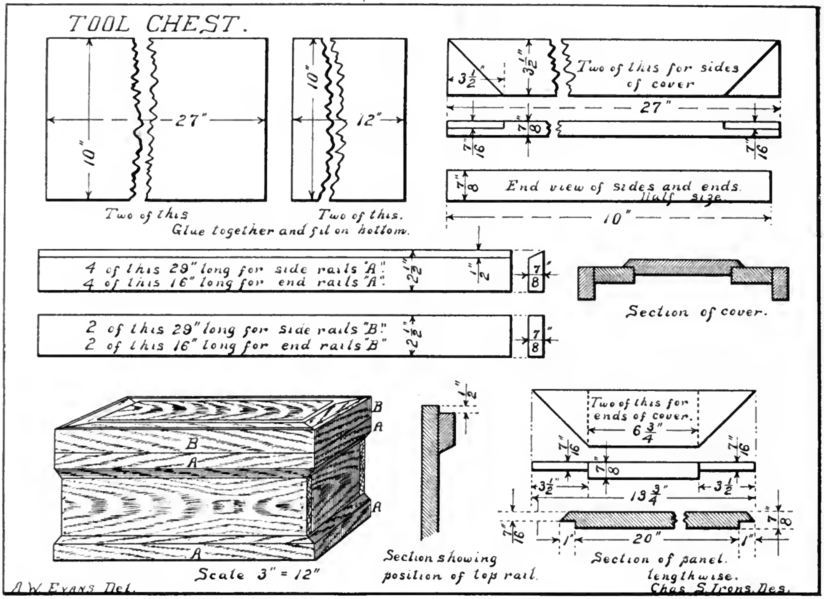
Stock, ⅞" Oak.

The holes for dowel rods are to be made ½" deep and not entirely through the stock as shown at A in drawing.

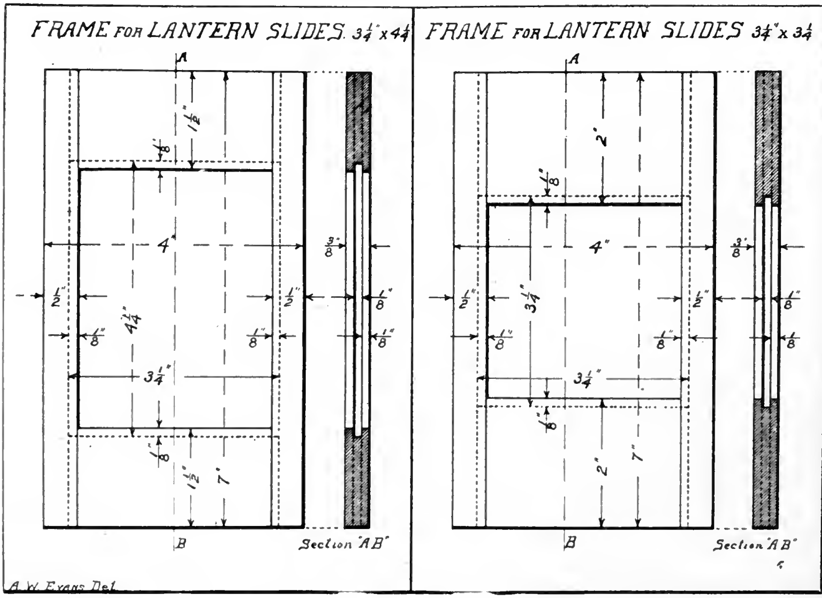
Bolts required, with two washers to each bolt: Two ¼" x 1¾", Two ¼" x 2⅝", and Four ¼" x 1½".


WINDOW BOX.
1/8" Chamfer.
Rebate 1/4" Deep.
Not to exceed 24"
1 Side like this and one plain
3/8" Hole for Dowel
End
2 Like this.
2 9/16" less than side.
Bottom
Evans Del.
Grant Beebe Designer.

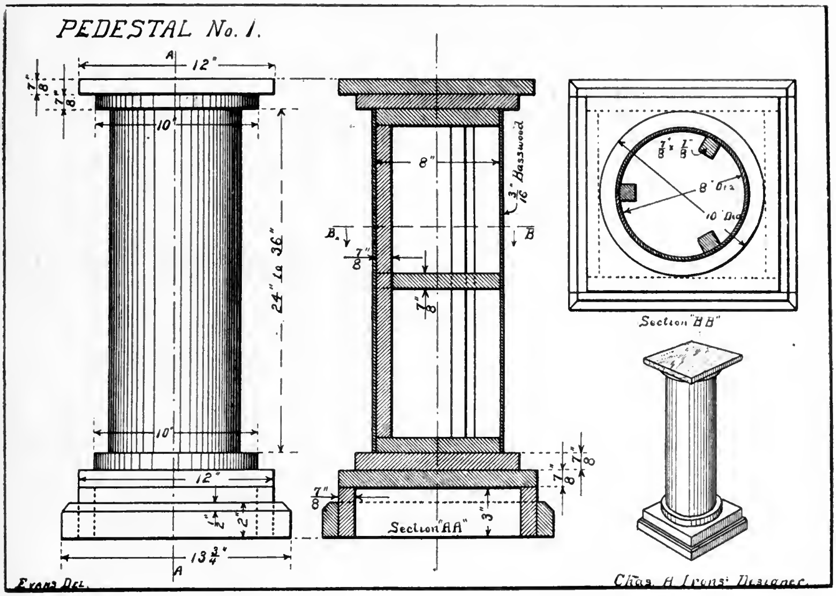

NATURE STUDY CARRYING CASE.
1" Butt
3/4" Bit
1/2" Bit
3/8" Bit
Test Tube Rack.
Candlestick.
Evans Del.
Hiram Shepard Des.

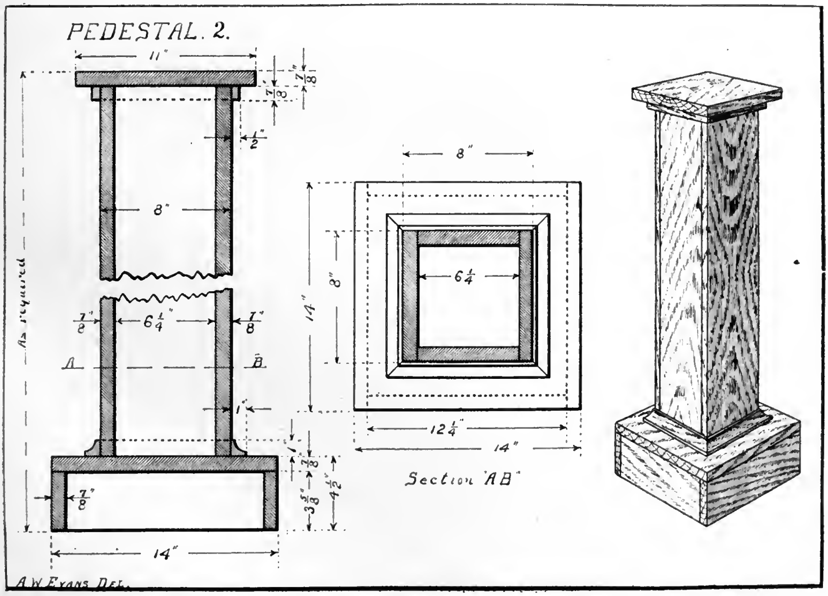


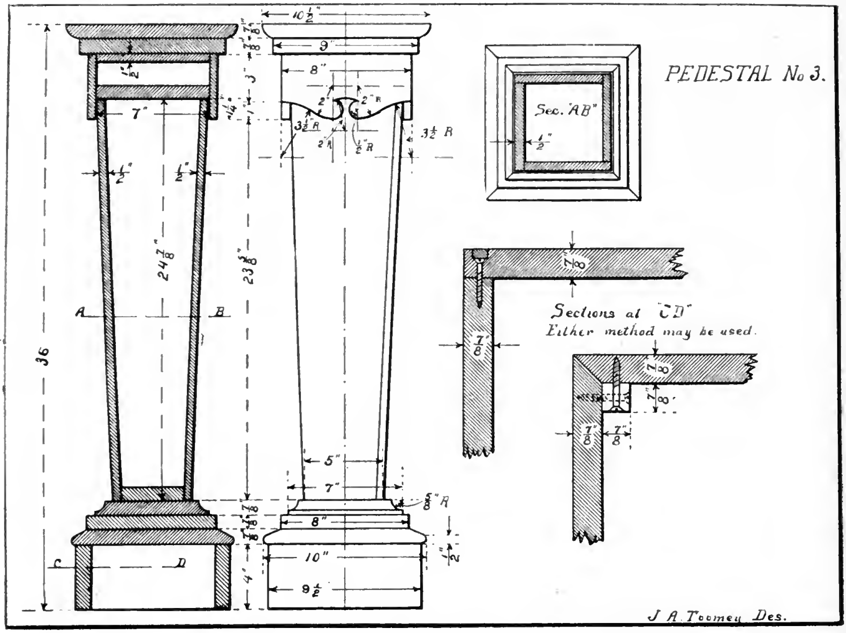
Tool Chests should be made of Hardwood.

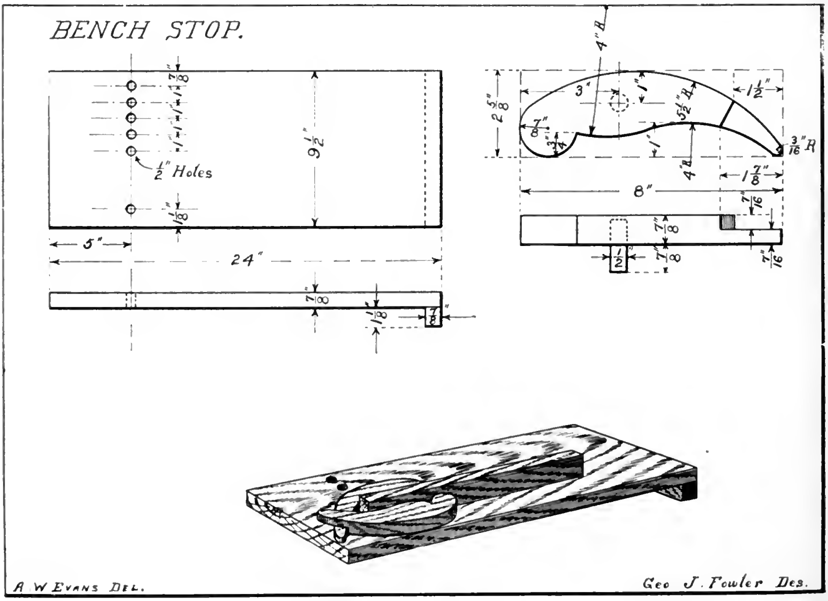


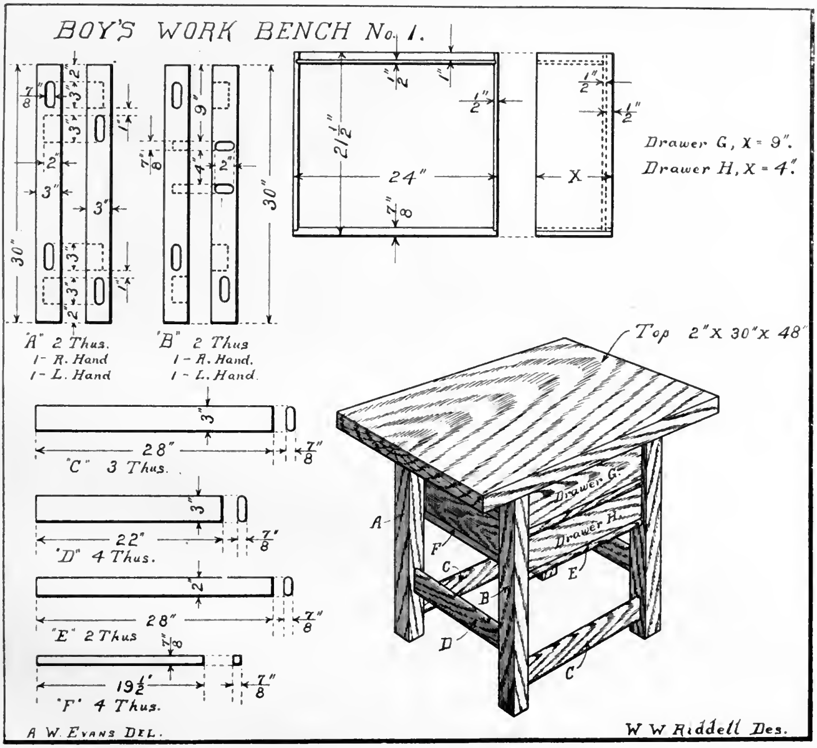
These Frames should be made of red cedar or Spanish cedar.


PEDESTAL No. 1.
Section "AA"
Section "BB"
3/16" Basswood
8" Dia
10" Dia
24" to 36"
13 3/4"
Evans Del.
Chas. A. Irons: Designer.

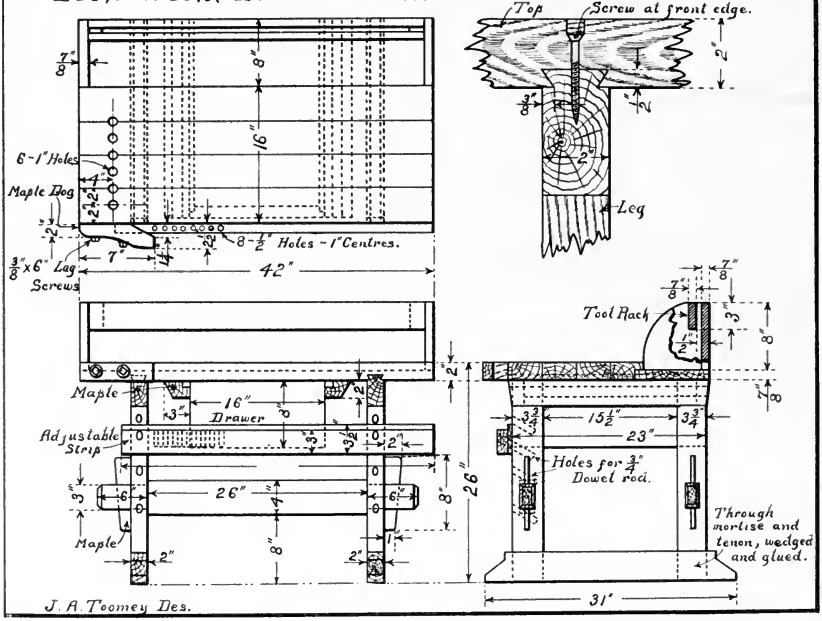

PEDESTAL. 2.
As required
Section "AB"
12 1/4"
14"
A. W. Evans Del.


PEDESTAL No 3.
Sec. "AB"
Sections at "CD"
Either method may be used.
J. A. Toomey Des.

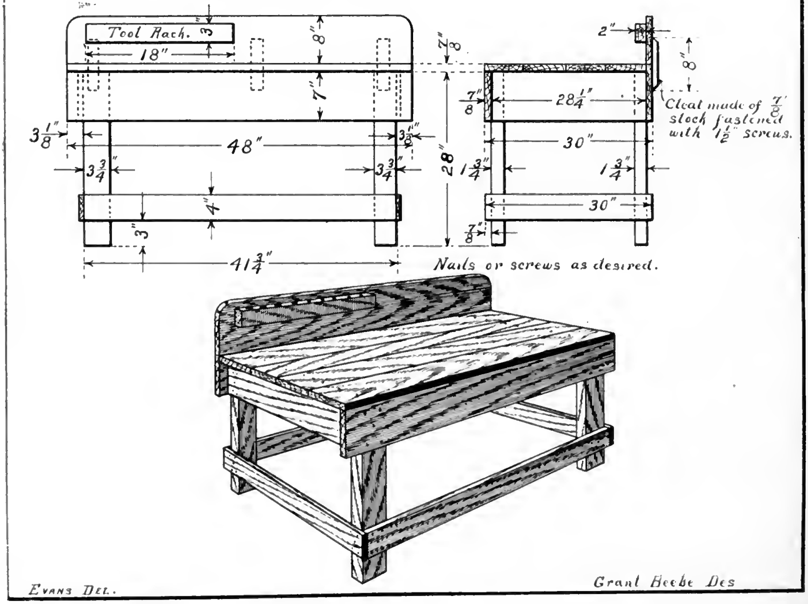

BENCH STOP.
1/2" Holes
A. W. Evans Del.
Geo J. Fowler Des.


BOY'S WORK BENCH No. 1.
"A" 2 Thus. 1 - R. Hand 1 - L. Hand
"B" 2 Thus 1 - R. Hand. 1 - L. Hand.
Drawer G, X = 9".
Drawer H, X = 4".
Top 2" X 30" X 48"
"C" 3 Thus.
"D" 4 Thus.
"E" 2 Thus
"F" 4 Thus.
Drawer G.
Drawer H.
A W. Evans Del.
W W Riddell Des.

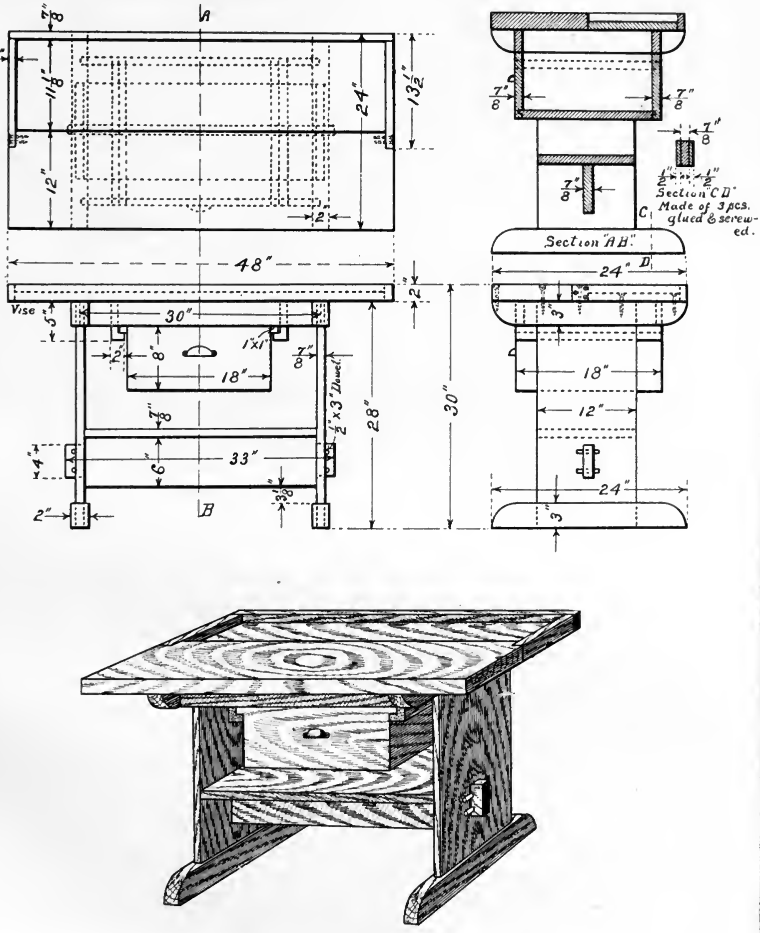
BOY'S WORK BENCH No. 2.



BOY'S WORK BENCH No. 3.



BOY'S WORK BENCH No. 4.



Note – Drawer 18" x 8" may be replaced by two 26½" x 6" or left out using space as shelf.

A W Evans Del.   Chas. S Irons Des.

Fig A

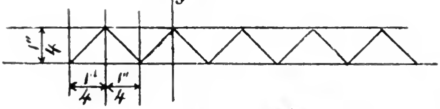


Fig. B.

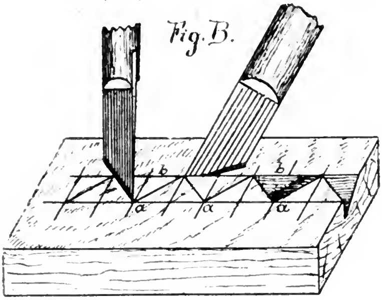


Fig. C.

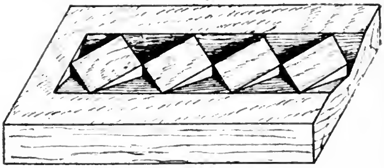
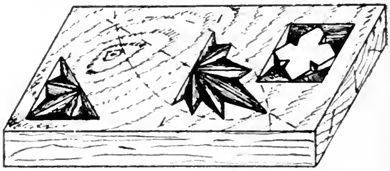


Fig. D



CHIP-CARVING.

Chip-carving, sometimes called "peasant-carving," is the development of the "savage's delight in notching with a knife the wooden implements and objects of his daily use." As a home industry it has been most fully developed in Scandinavian countries, by the peasants, during the long evenings of winter. As a means for the decoration of objects made by the manual training classes, chip-carving has been found very attractive to the pupils and has stimulated them to greater effort in the accurate making of the objects to be decorated, for no piece of work may be ornamented unless it is the product of the pupil's best effort.

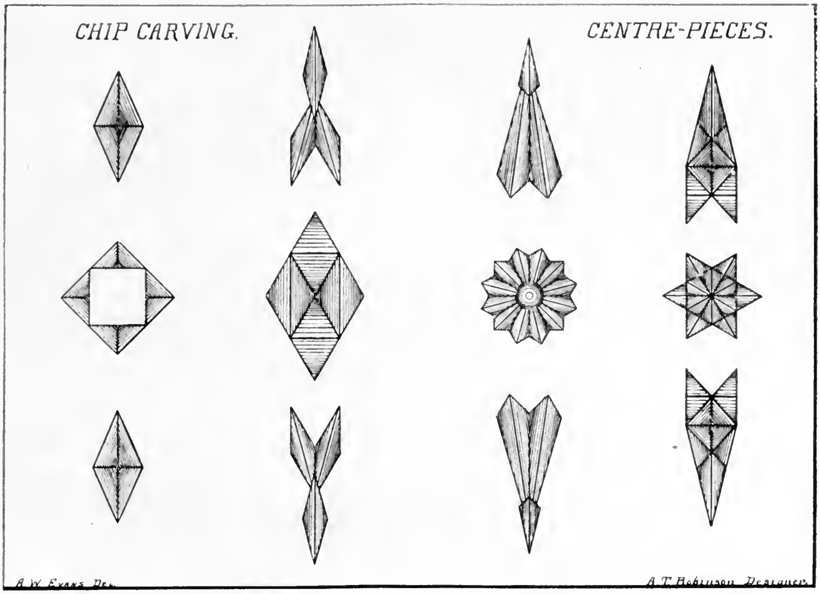
Fig. A represents the method used in marking out the simplest form for chip-carving. Fig. B shows the position of the knife* in cutting. Holding the knife vertically, place the acute angle in the corner (a) to be cut deepest, pressing it hard into this corner, let the edge of the knife sink into the line till it touches the upper border line. Make these vertical cuts on both sides of the triangle. Then, holding the knife at about thirty degrees from the horizontal, remove the triangular chip (b).

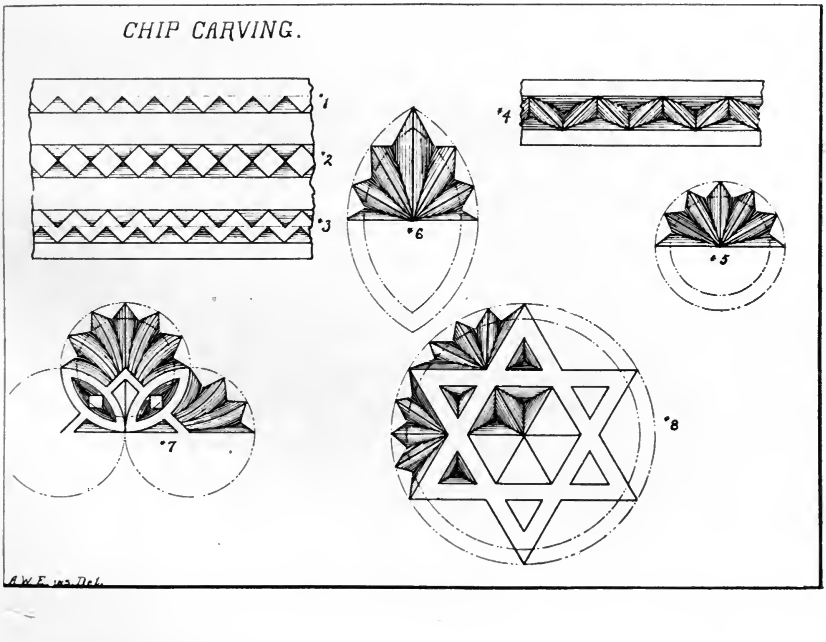
Fig. C shows a design formed by doubling the line of triangles. Fig. D shows slight variations and a square like those in Fig. C, but notched on four sides.

Designs for chip-carving should always be very carefully drawn with a sharp pencil.

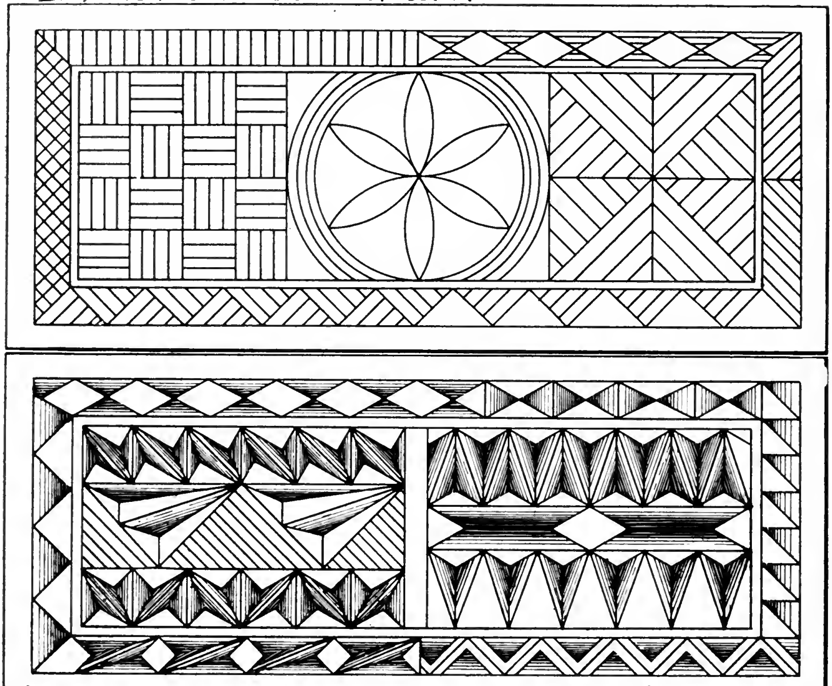
Children should plan their own designs as soon as they have learned the general method and have acquired some skill.

* See page 30.

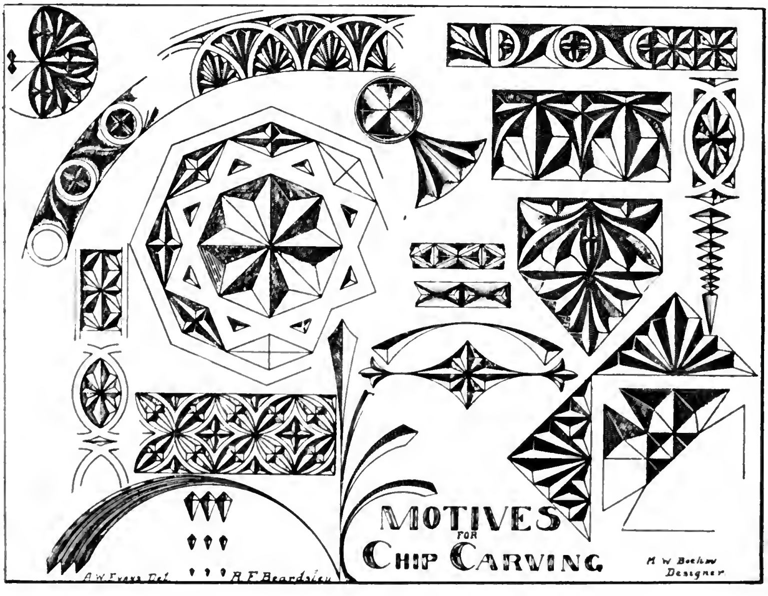

CHIP CARVING.
CENTRE-PIECES.
A. W. Evans Del.
A. T. Robinson Designer.

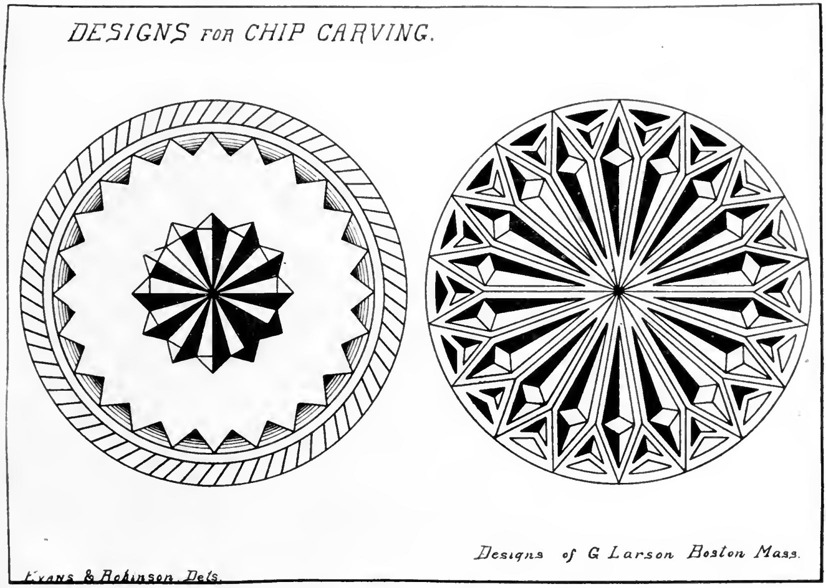

CHIP CARVING.
*1
*2
*3
*4
*5
*6
*7
*8
A. W. Evans Del.

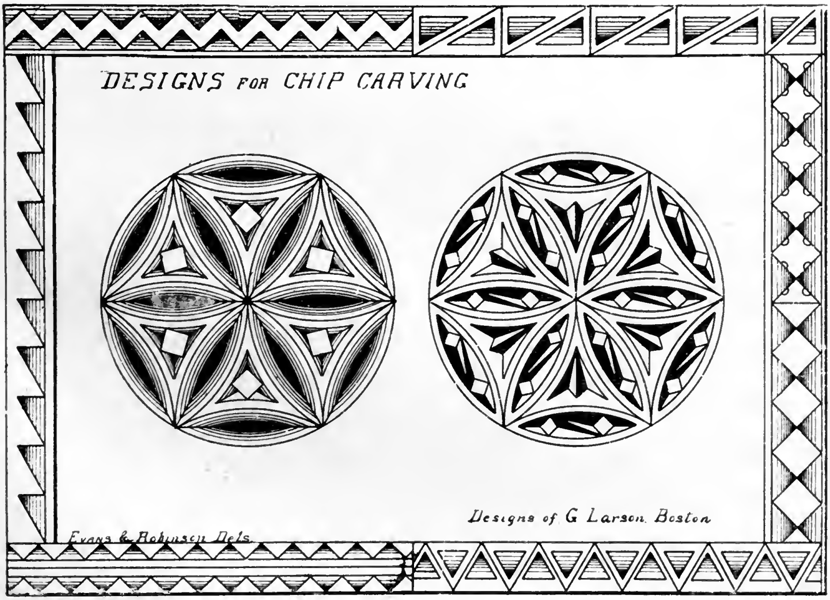
DESIGNS FOR CHIP CARVING.



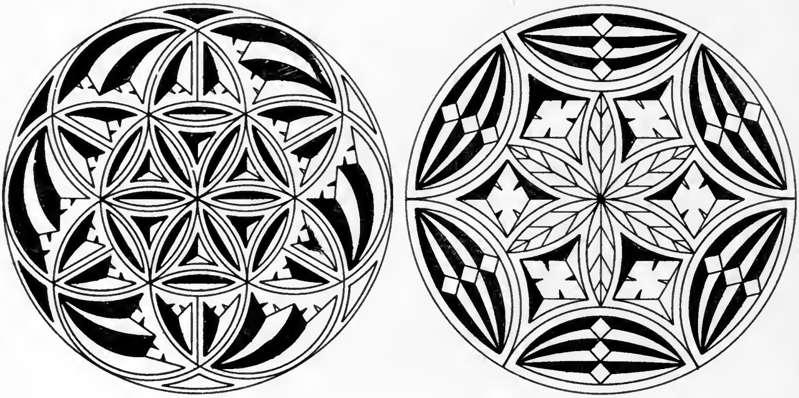
A. W. Evans Del. Designs of G. Larson Boston.




DESIGNS FOR CHIP CARVING.
Designs of G Larson Boston Mass.
Evans & Robinson Dels.


DESIGNS FOR CHIP CARVING
Designs of G Larson. Boston
Evans & Robinson Dels.

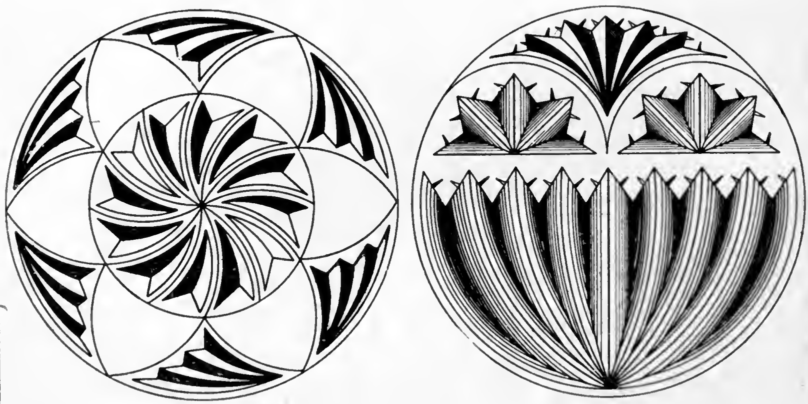
DESIGNS FOR CHIP CARVING.



Designs of G. Larson Boston Mass.

Evans & Robinson Dels.

DESIGNS FOR CHIP CARVING.



Designs of G. Larson Boston.

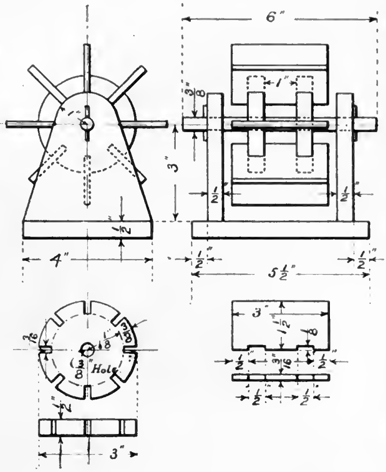
Evans & Robinson Dels.

CHIP CARVING

Design of G Larson Boston Mass

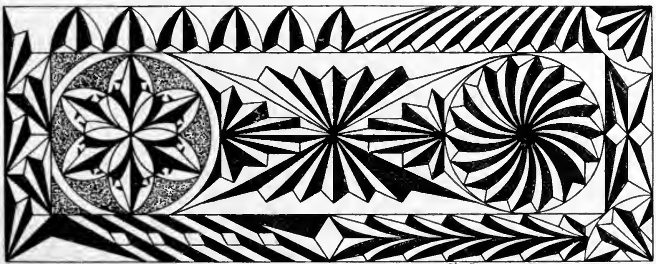
Evans & Robinson Dels.

WATER WHEEL. No 1



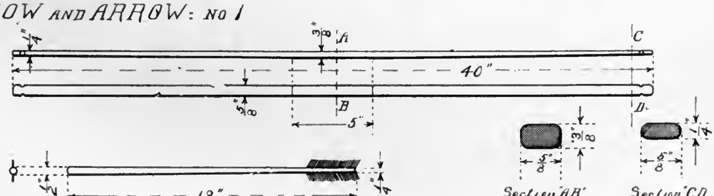
A. W. Evans Des.

CHIP CARVING.



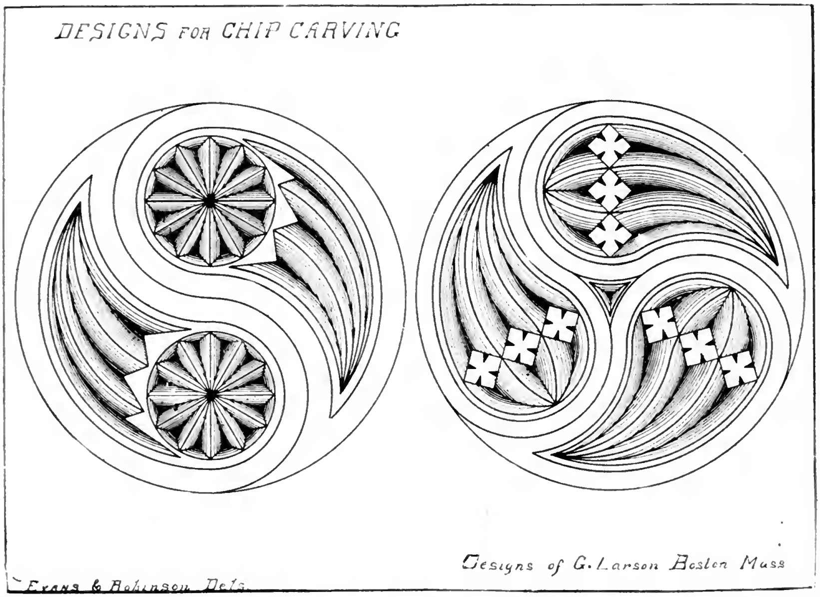
Design of Mr G. Larson Boston.

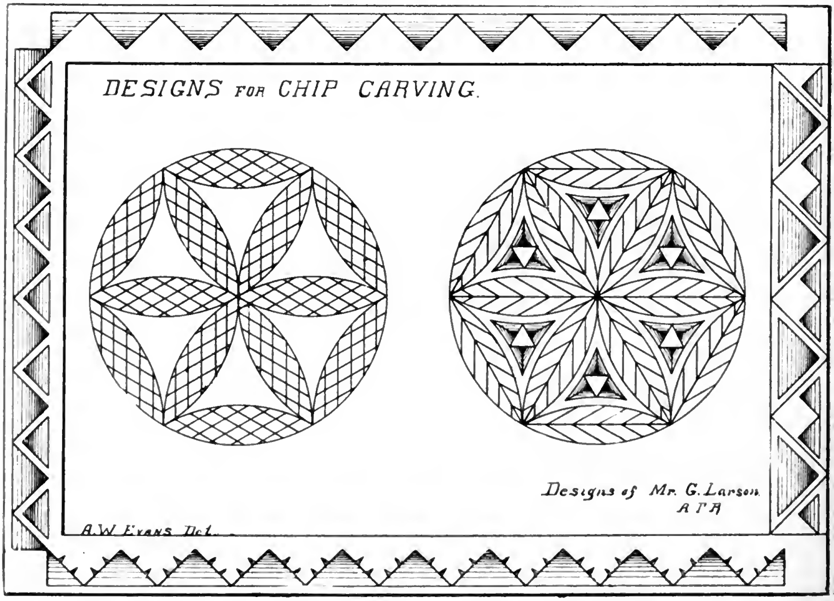
BOW AND ARROW: No 1



Evans & Robinson Dels.

A. W. Evans Des.


DESIGNS FOR CHIP CARVING
Designs of G. Larson Boston Mass
Evans & Robinson Dels.


DESIGNS FOR CHIP CARVING.
Designs of Mr. G. Larson.
A T A
A.W. Evans Del.

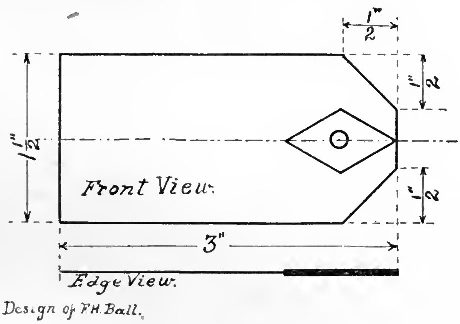
CONSTRUCTIVE WORK.

EXAMPLES OF CONSTRUCTION IN VARIOUS MATERIALS.

In order that constructive work may represent something more than either amusement or even training for skill, the articles made should be the outgrowth of the child's mental activity, should each represent an idea which is propagated by the class-room work. The shipping tag would be a logical incident in the study of commercial geography. The tipcat* might form an incident in the illustration of amusement as opposed to the necessity for commercial life.

The directions here given for making are intended only as guides to the teacher. The arrangements of steps should be thought out by the pupils. Material being given and a motive furnished to the worker, his own mental activity should accomplish the plan if allowed free play.

SHIPPING TAG.—Suitable for use in grades one to four inclusive.



Stock: Heavy manila paper.

Tools required: Pencil, rule, scissors and punch.

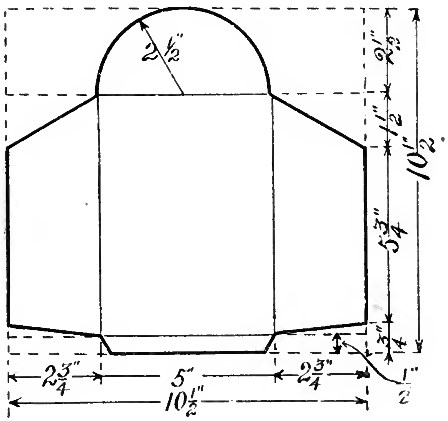
Directions: Give the pupil a piece of manila paper, some-

* See page 63.

what larger than the tag to be made. Measure and mark the length of the tag from an edge which is already straight, and rule a light line parallel to that straight edge. Cut on this line.* Measure the width at each end, rule the line for the width and cut on that line. Measure one-half the width at each end, and rule the center line on both sides of the tag. Mark and cut the corners as shown in the drawing.

Have the children design the form to be used in strengthening the eyelet. This is to be cut in duplicate from manila paper and pasted or glued to each side of the tag. Punch the hole when the glue is dry.

An Envelope (for holding work in process of construction). Suitable for all grades.



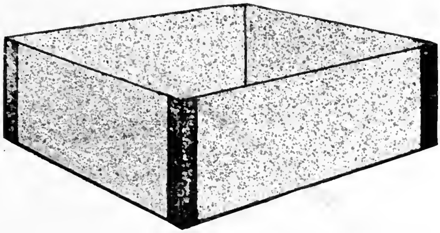
Stock: Heavy manila paper, 10½" x 10½".

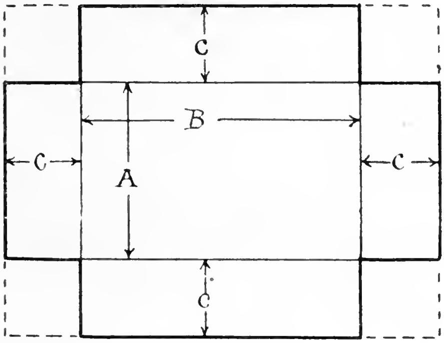
Tools: Pencil, rule, compass and scissors.

Directions: Measure and mark the heavy outline as shown in the development. Fold on light lines and glue the side and bottom flaps. This makes an envelope measuring about five by seven inches. Pupils should be allowed to plan envelopes for certain specific purposes. It is well to show the class various forms of envelopes opened out noting the number and relative sizes of its various parts, that the flaps are longer than the half width, etc.

* See page 30.

CARDBOARD BOXES.—Suitable for all grades.





DEVELOPMENT.

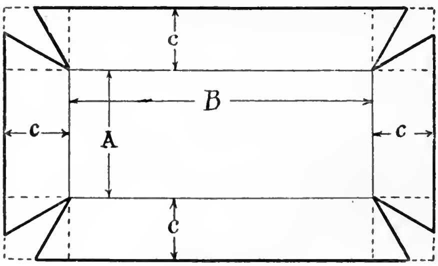
Stock: Strawboard, jute or heavy "folding board."

Tools: Pencil, rule and knife.

Directions: The perspective shows the shape of a box made in about the proportions shown in the development. The corners are bound with bookbinder's adhesive cloth which is the most convenient and serviceable material to use in binding all cardboard constructions. Gummed paper may be used if more convenient. The drawing which is marked development represents a flat piece of cardboard, marked and cut ready to be folded and bound at the corners. The dimensions A and B determine the width and length of the box to be made, dimensions c, c, c, c, determine the depth of the box. The light lines bounding the central rectangle indicate that the cardboard has been cut on these lines only partly through. The heavy outline indicates the lines on which the cardboard is cut entirely through, and the dotted lines indicate a part which is to be or has been removed. These forms of representation in cardboard work will be adhered to throughout these articles.

After explaining the general method, as indicated above, the children should each plan a box for some specific use. They should each determine the size of stock which will be necessary in making their boxes. When completed the boxes may be decorated either with drawings or with conventional designs cut from colored paper. Let the children plan a cover for their box—this might be a rectangular tube for the box to slide into or a shallow lid, or like a cover to most candy boxes, as deep as the box itself. Which would be the strongest, most convenient and cheapest?

CARDBOARD TRAYS.—Suitable for all grades.



DEVELOPMENT

Stock: Strawboard, jute or heavy "folding board."

Tools: Pencil, rule and knife.

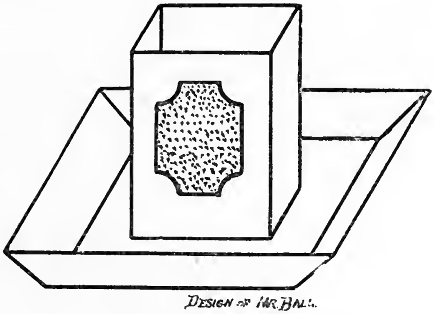
Directions: The directions given for the Cardboard Box are applicable in every respect to the Tray.

MATCH SAFE.—Suitable for all grades.

Stock: Strawboard, or heavy folding-board.

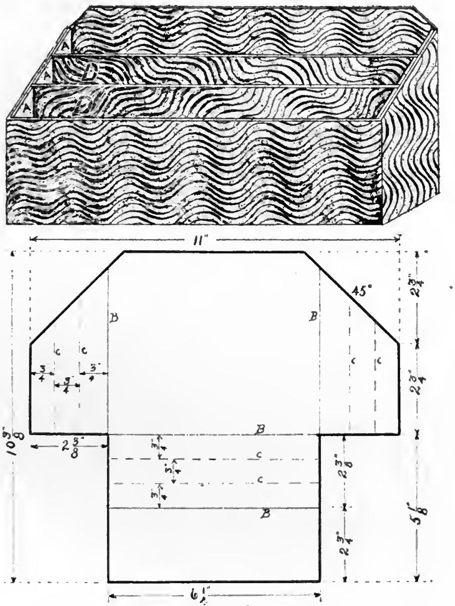
Tools: Rule, pencil and knife.

Directions: Make the tray in the same manner as was shown for a similar tray above. The bottom of this tray should measure



about 2½″ x 3½″. Make the holder in the same manner as for a box about 2½″ high by 2″ wide by 1″ thick, Glue the bottom of the holder to the inside of the tray and glue on an ornamental sandpaper scratcher as shown.

STATIONERY CASE.—Suitable for all grades.

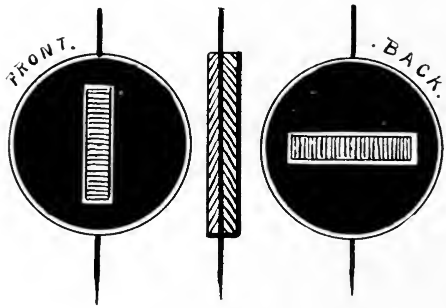


Stock: Strawboard, jute or heavy folding-board.

Tools: Rule, pencil and knife.

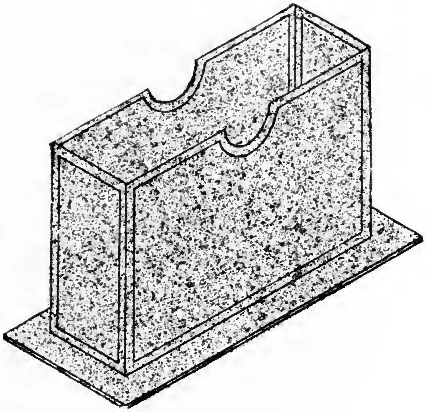
Directions: Draw the outline as shown by heavy lines and cut out to that shape. Cut the lines B B B B partly through for folding. On the reverse side draw the six lines marked c. These are to locate the partitions D, which are shown in the picture. Now cover the strawboard on each side with fancy paper, bend and glue to shape. Make the partitions D and glue the edges to the sides and base of case on the lines c. Cut out six strips (A) about $\frac{11}{16}''$ wide and $5''$ long which are to be glued in place as shown in the picture and afterward trimmed even with the top edge of the case.

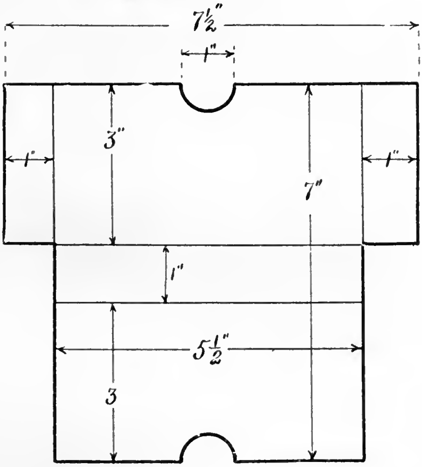
A Thaumatrope.—This simple form of thaumatrope is very convenient for illustrating the duration of optical impressions. The disks are of cardboard glued together with a needle between.



Both disks are to be edged and covered with black paper before gluing together. Strips of red glazed paper are fixed in the middle on each side, one horizontally and one vertically. An outline of white paint around the red will add greatly to the effect. When balanced between the thumb and finger and rapidly rotated, a red cross appears, due to the persistence of the impression upon the retina.

ENVELOPE CASE.—Suitable for all grades.



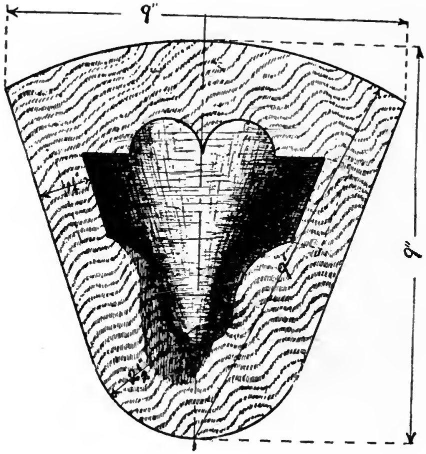


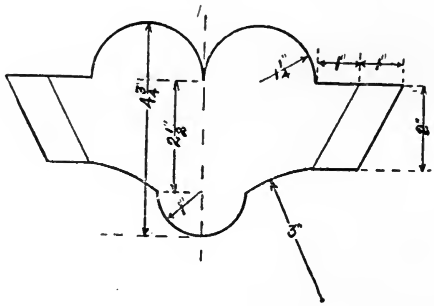
Stock: Strawboard or heavy folding board.

Tools: Pencil, rule, compass and knife.

Directions: The only special directions required, other than those which have been previously given, are that the dimensions for the length and width may be varied to suit the size of envelopes or cards to be held, and that the base is a separate piece to which the case is glued.

BRUSH HOLDER.—Suitable for all grades.



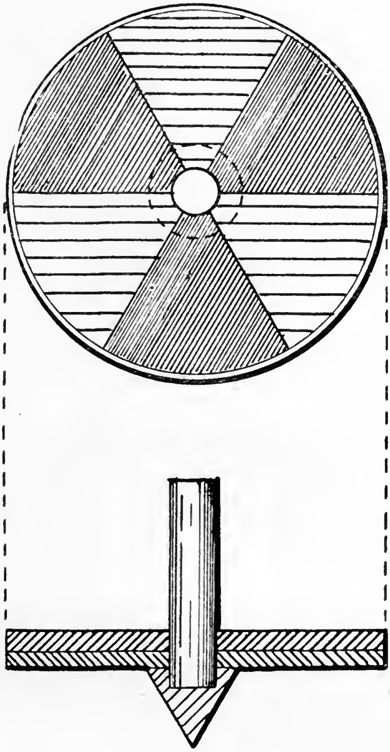


Stock: Strawboard covered with fancy colored paper.

Tools: Rule, pencil, compass and knife.

Directions: Mark and cut out the shape for the back and then cover it with colored paper. Cut the slots to receive the flaps of the pocket at a distance of one and one-quarter inches from the edge and two inches long, parallel to the slanting edges. Now mark and cut out the pocket as shown in the drawing (the shape may be varied at pleasure). Cover with colored paper and then cut the lines for the fold. Slip the flaps of the pocket through the slots in the back piece and glue them firmly to the back.

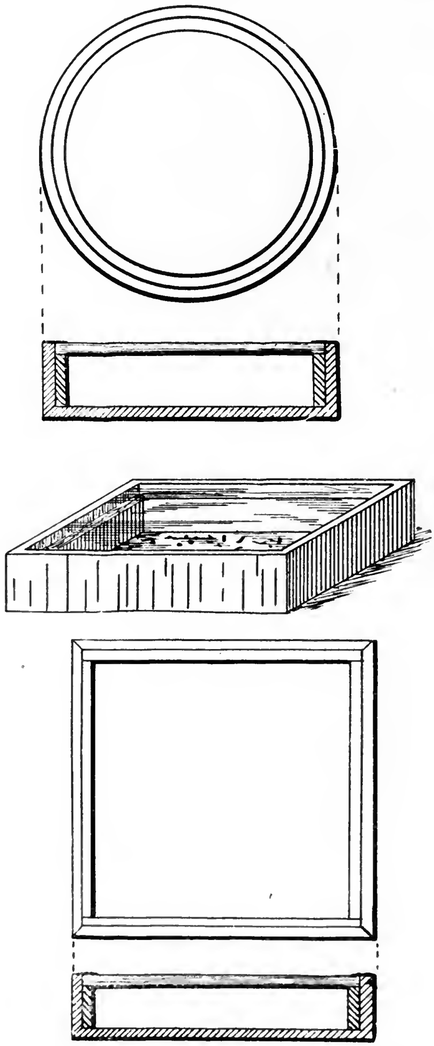
A Top.—(To illustrate the secondary colors produced by rapid rotation.)



Two or more disks of strawboard or thin wood are cut out and glued together, a 1/4″ hole being either punched or bored through the center. The point is to be made of wood, cone shaped, and a short length of 1/4″ dowel rod fastened into it with glue as shown. The disk is then to be bound on the edge with dark paper, as also the under surface. The upper surface of the disk is to be covered with a sheet of either blue or red paper, and sectors of red or yellow are to be glued on top of this at equal distances apart.* Fasten the disk in place with glue. The rapid rotation of this top will produce the appearance of violet (blue and red), or orange (red and yellow), the effect being due to the duration of the impression of light.

* Six sections of red or yellow are better than three.

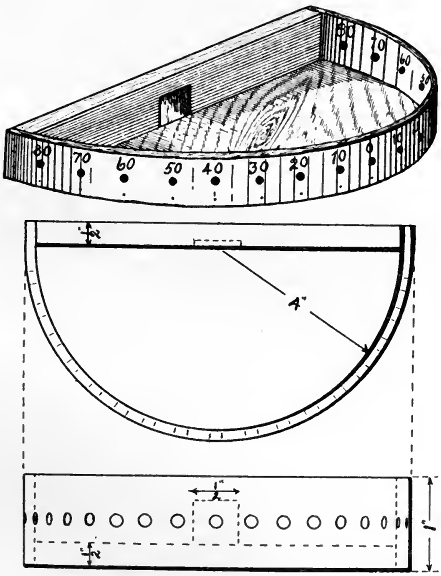
An Electric Toy.—The drawing represents an electric toy which is designed to amuse very young children and to instruct older ones. It illustrates the attraction of unlike and the repulsion



due to like electric polarity. The box may be made either square or circular, of strawboard, and should be neatly covered with colored paper. A ring, narrower than the height of the box, should be glued inside to serve as a support for the glass cover, which is to be held in place by a binding of linen or strong paper. Before fixing the glass in position, place a number of bits of paper and charcoal (burnt matches broken small) in the box.

If the glass is now rubbed with flannel or silk the paper and charcoal will be attracted so forcibly that they will jump up and cling to the glass until they become charged with electricity from the glass when they will be as forcibly repelled and will continue dancing back and forth for some time or until they have conducted away all of the electricity from the glass cover. The sizes of the boxes will be determined by the size of the glass squares or disks obtainable.

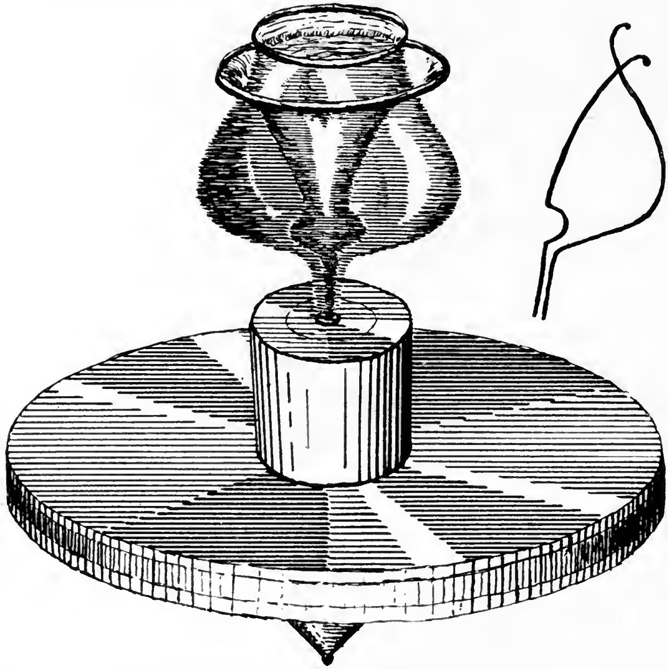
Apparatus to Illustrate that the Angle of Reflection of a Ray of Light is Equal to the Angle of Incidence.—The



back piece, 8″ long, is made from pine wood with a small piece of mirror is let into the center flush with the face of the board. The base, a semicircle, is to be made of ¼″ wood. The arc, made of thin basswood or strawboard, should be divided before bending.

The divisions are shown as ten degrees apart, but may be any equidistant spaces. Holes are drilled at each division. If now, a light is held near a hole on either side of the center (o), its reflection can be seen only through a hole equally distant from the center on the other side.

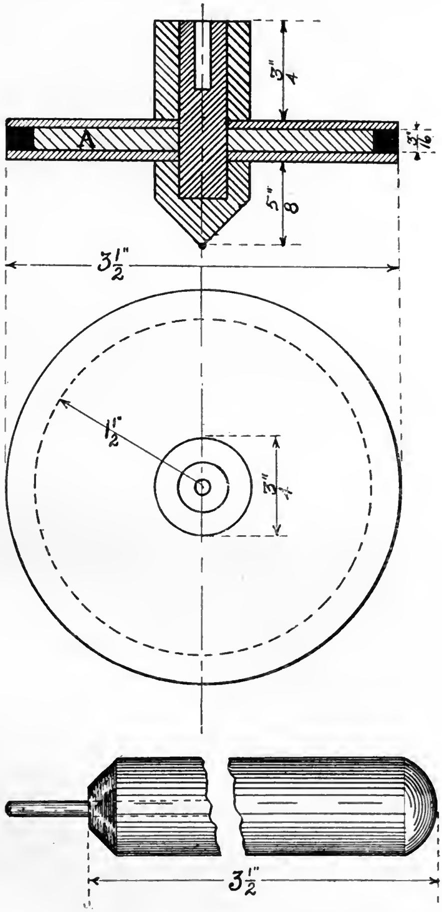
A Scientific Top.—In addition to the endless amount of



amusement to be derived from the spinning of tops, this form of toy has come to be a most useful piece of apparatus for demonstrating certain laws of light and of motion.

How many boys can tell the reasons for the following phenomena of a rapidly spinning top? Why does it continue to revolve after being set in motion? Why does it persistently remain in a vertical position in spite of attempts to tip it over to one side? Why does not a top spin longer when its speed is increased? Why does a heavy top spin longer than a light one?

The top shown has been designed for use as a manual training exercise and is, therefore, not such an accurate or heavy instrument as is to be found in a physical laboratory, but many experiments of interest and value may be performed with it and the skill necessary to produce a well balanced top will teach a lesson in care which should be invaluable.



Directions for Making.—Cut out a disk (A) 3″ in diameter from a piece of wood about 3-16″ thick. The black squares shown in the sectional view represent a ring of lead which is fastened to the edge of disk A and is placed there to give weight to the top, in the same manner that the rim of a fly-wheel is made thick and heavy in order that it may store up energy. The ring may be made either by hammering a piece of lead to the form of a long (10″) ribbon and bending it around the disk where it is nailed in place, or it may be cast by melting the lead and pouring into a suitably prepared mould which is easily made of wood. The forging method is, however, the easiest.

Having made and fastened the rim in place, cut out two disks of thin wood 3½″ in diameter to be used as covers. Glue these to disk A. While the glue is drying, make the spinning point, as shown, from dowel rods, and also the ring for the cord with which the top is to be spun. The handle may also be made at this time by drilling a hole into the end of a short dowel and driving into it a heavy piece of wire. Now bore a hole through the three disks. This hole must be exactly in the center and must be at right angles to the face of the disks. Glue the point and spindle in place as shown. Clean with sand paper and bind the edge of the disk with paper or cloth to hide the lead rim and also to prevent its becoming loose.

Color disks, bent wires and pieces of cardboard may be placed in the hollow of the spindle while the top is spinning, and will produce wonderful and beautiful forms, which are all due to the persistence with which the eye retains an impression.

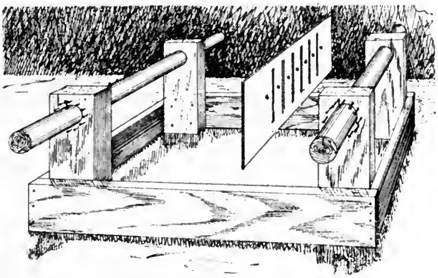
LOOMS.

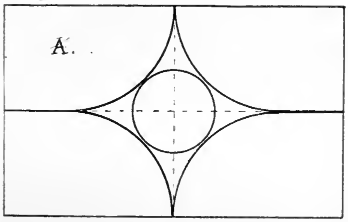
Cigar-Box Loom.—Figure A represents the lines to be drawn on the cover of a cigar box, which, when sawed out, will form the uprights for supporting the rollers. The circle is to be notched and used as a ratchet when fastened by means of brads to the end of one or both of the rollers.

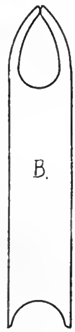
A nail driven through the upright to engage the teeth of the ratchet wheel serves to admit of tightening and winding of the fabric. The roller may be made from dowel rods or broom handles.

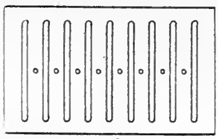
Figure B represents the best design we have seen for a Weaving Shuttle. It is easily made of thin wood, either basswood or a piece of a cigar box. The curved arms at the top will spring sufficiently apart to admit of winding the yarn. The length of the shuttle should be somewhat greater than the width of the loom.

THE CARD.—Figure C may be made of strawboard or wood. Its length should be less than the distance between the uprights of the loom, in order that it may be used to press together the cross strands of the fabric while weaving. The distance between the holes in the card is about ¼″. No explanation is necessary for the making of the first loom because of its simplicity.

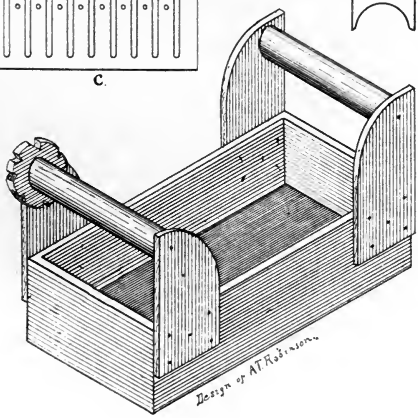






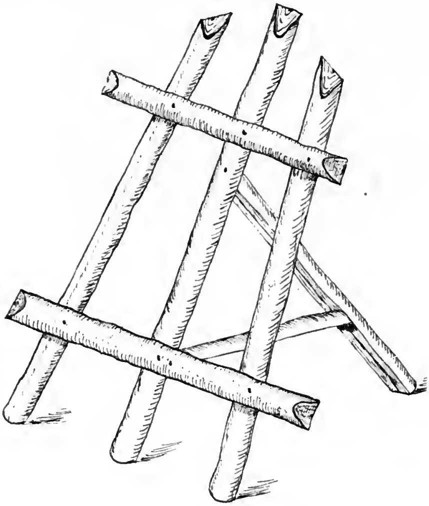


C.

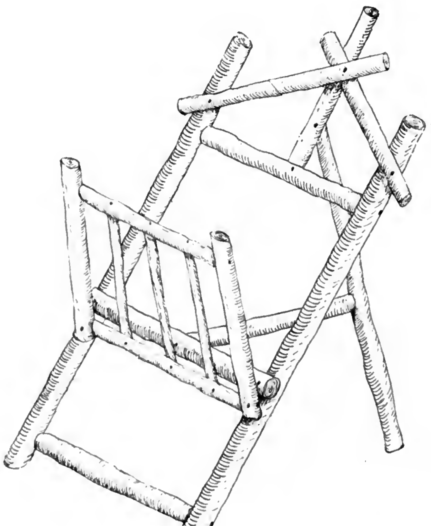


RUSTIC WORK.

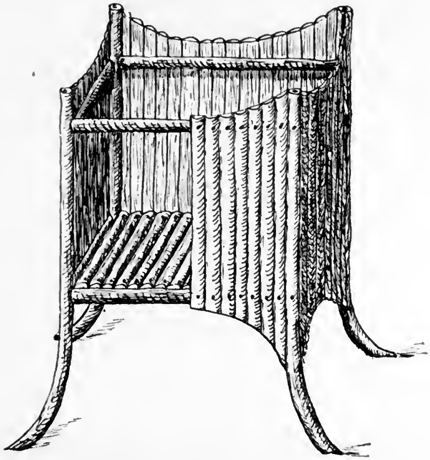
In presenting the following suggestions for rustic work I have



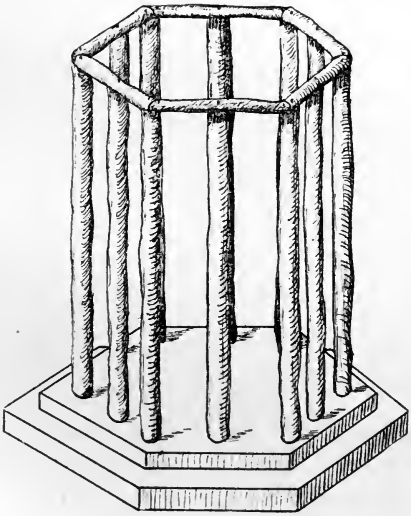
in mind the value, in connection with the Nature Study, of bringing the products of that study into the school room, and instead



of throwing them away as valueless after study and discussion, to



use the withered twigs, acorns and leaves for decoration and construction. The tools (a knife and a hammer) necessary for this work are so few and simple that almost any school can have them



and the work is of such a nature that it may be carried on in the ordinary school room.

The first is a design for an *easel* which is to be made of twigs which have been whittled flat on one side. The second is a *newspaper* or *music rack* made of branches, which are left round with the bark on and merely cut to length and nailed together. No dimensions are given, the intention being that the children will make the objects of such a size as will meet the requirements for practical use. The rack may be made as small as the easel and used for holding envelopes or postal cards or it may be made three or four feet high and used for holding music or newspapers.

The flower basket is to be made from branches or twigs flattened as in the easel and can be any size from six inches to three feet high according to its intended use, in the house or on the lawn. Thoroughly dry twigs are better than green branches for rustic work.

The umbrella stand is to be made of rather large branches, nailed together as shown, the lower ends being firmly driven into holes previously bored through the upper base piece. The two hexagons which form the base are to be screwed together from underneath. No dimensions are given, as it is expected that each child will work out the proportions for himself.

The following is a list of objects which may prove suggestive for rustic work :

Ladder, stands for flower pots, saw-horse, fruit basket, picture frame, frame or trellis for vines, chair, either garden or folding, garden seat, garden table, three legged stool, hanging basket, sponge rack, waste paper basket, dog kennel, bird house and shoe box. The latter may be made from any old soap or starch box and covered with split twigs; it is then a rather ornamental piece of furniture.

WIRE WORK.

The wire required for this work is tinned-iron wire, No. 20, S. W. G. (standard wire gauge). The tinned wire costs slightly more than either black or bright wire, but is by far the best for children's work because it does not rust easily. Wire is sold in coils, on spools or in bundles of straight pieces. The latter is the best for our use for we will not have to straighten it as would be necessary with coiled wire.

Many useful as well as ornamental articles can be made from wire, and, because of its cheapness and because only one tool is required for its manipulation, wire work forms a most useful subject for manual training exercises.

The Pliers.—This tool is a pair of pincers for cutting, holding and bending the wire. There are several kinds, but a combination of three kinds is most suitable for our work. It has a cutting edge that enables us to cut the wire to any desired length; it has flat jaws for holding the wire and for bending angles, and it has a round nose for bending curves.

Each pupil should be provided with a pair of pliers and short piece of wire. The first lesson should consist in the practice of forming such shapes as A, B, C and D, and also the loops (Fig. 5) which are used in joining parts of a completed object.

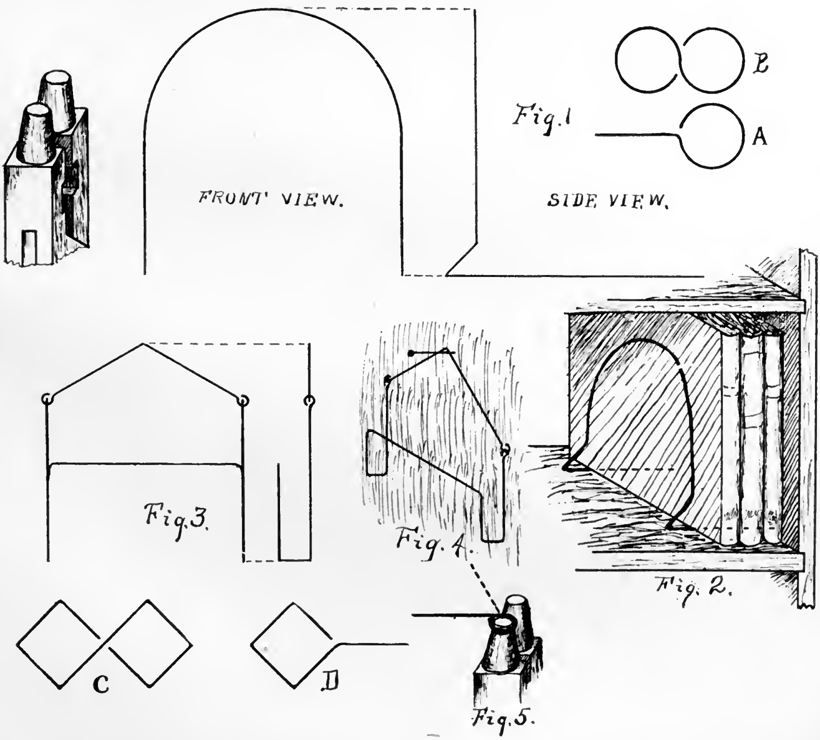


Fig. 1 represents the shape to be bent for a book support and its application is shown in Fig. 2. The size will be determined by the work to be held by the support.

Fig. 3 and Fig. 4 show the drawing and picture of a hanging letter rack, made from two pieces of wire joined by loops, bent as in Fig. 5.

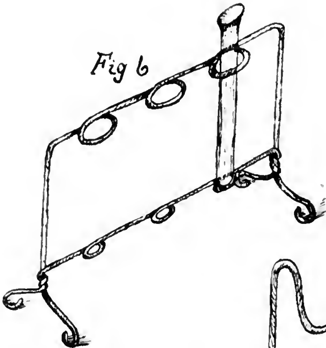


Fig 6

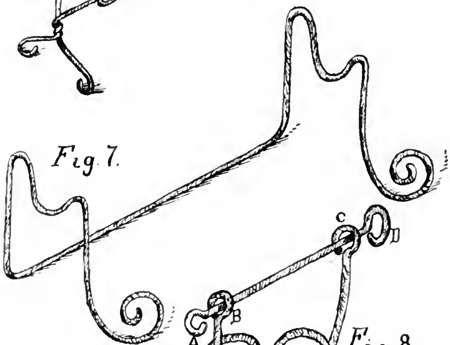


Fig. 7.

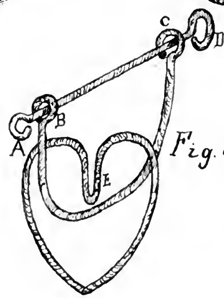


Fig. 8.

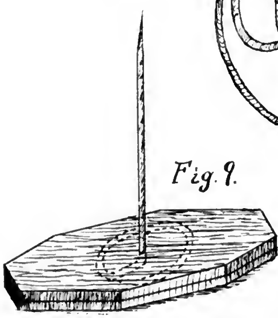


Fig. 9.

Fig. 6 represents a wire rack for holding three test tubes. If you are using test tubes in your nature study work you will appreciate the value of this rack as a constructive exercise.

Fig. 7 shows a very simple pen or pencil rack, which is capable of great variation in design, and I would recommend that, if made by the class, each child plan the shape to which the legs are to be bent.

Fig. 8 is the most complex form we have yet attempted. It represents a wire puzzle, the feat being to remove the heart without bending any of the wires or opening the loops. Loops A and B are to be made small, just large enough to admit the straight piece of wire. Loops C and D are to be made large enough for the passage of the U shaped part of the heart (E), but C should not be large enough to allow D to pass through it.

Fig. 9 represents a bill or memorandum file made of wire and either wood or pasteboard for a base. The two pieces for the base are hollowed in the center to take the loop of wire which holds the spindle vertically; the two pieces for the base are to be fastened together with glue.

VENETIAN IRON WORK.

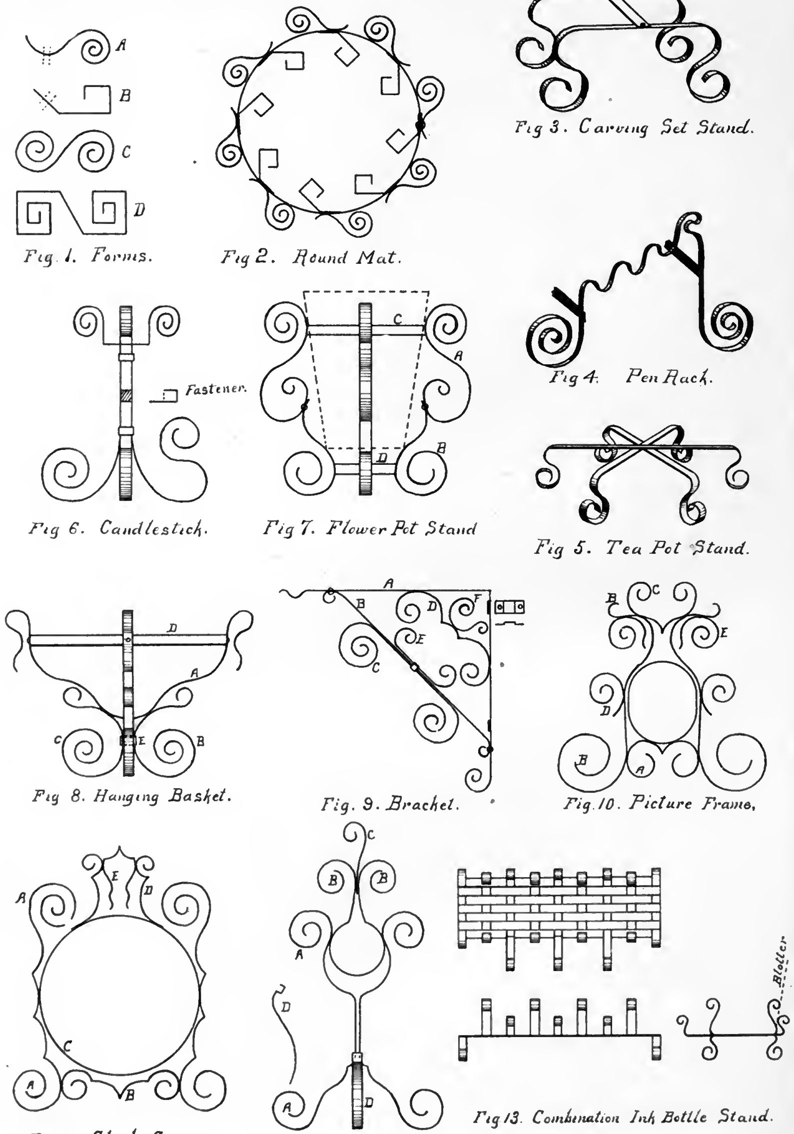


Fig. 1. Forms.

Fig 2. Round Mat.

Fig 3. Carving Set Stand.

Fig 4. Pen Rack.

Fig 5. Tea Pot Stand.

Fig 6. Candlestick.

Fig 7. Flower Pot Stand

Fig 8. Hanging Basket.

Fig. 9. Bracket.

Fig. 10. Picture Frame.

Fig 11. Clock Case.

Fig 12. Easel.

Fig 13. Combination Ink Bottle Stand.

A. W. Evans Del. G. A. Hancock Des.

Paper Pulp Map of South America made by sixth grade pupils in the Thomas Hoyne School. This map has not been tinted or mounted. It shows the grain of the pulp and the marks of the fingers.

Paper Pulp Map of North America made by sixth grade pupils in the Thomas Hoyne School. This map has been tinted to show climatic conditions and is mounted upon blue mounting-board.

See page 168.

MODELING IN PAPER PULP.

Paper pulp is a substance which anyone can easily make and use in place of clay, sand, putty or plaster of Paris for making relief maps and for modeling. The material costs nothing and is so clean and pleasant to work, it is a wonder paper pulp has not been more generally applied in constructive work.

MANUFACTURE OF PULP.

To make pulp or papier-maché, tear any waste paper, (newspaper or writing paper will do) into pieces not more than an inch square. Fill a bucket with these bits of paper and pour over it about a gallon of boiling water. Let the paper soak for five or six hours and then drain off the excess water. If now the mass of wet paper is worked vigorously with a stick, churning it and thus tearing the bits of paper very fine, you will have, at the end of a few minutes, an excellent quality of paper pulp. The pupils will enjoy the making as well as the using of this material.

MAKING OF MAPS.

To make relief maps, spread a layer of pulp about one-fourth of an inch thick upon a board, to somewhat the shape of the map to be made, and with a small stick, or better still, a clay modeling tool, press the edges of the layer of pulp inward to the correct outline, work up the mountain ranges, cut out the rivers and lakes and when through set the board aside to dry. When thoroughly dry the entire map can easily be removed from the modeling board and glued to a sheet of strawboard or heavy cardboard.

TINTING.

The map may now be tinted with water color paints, either to show physical features or political divisions, according as the class are studying elevations, locations, products or history.

A method frequently used to produce correct outlines is to have each pupil draw the map upon paper, erasing and correcting the drawing until a satisfactory outline is made. Then cut out along the boundary and use this paper map as a stencil with which to draw the outline on the modeling board.

BOOK MENDING.

By WALDO DENNIS, Principal Park Manor School.

TOOLS AND MATERIAL REQUIRED.

Glue-pot, Gas or Oil Stove, Glue Brush, Glue, Paste Brush, Square-end Knife, Round-end Knife, Needles, Linen Thread, Two Awls (one straight and one curved), Tissue Mending Strips, Opaque Mending Strips, Brass-bound Ruler, Marble Paper, Lining Paper, Strawboard, Cloth for backs (cambrick), Paper Folder,* Book Press, and Book Sewing Table.†

USE OF GLUE.

THE GLUE used by cabinet-makers is said to be too hard and brittle. For book work a glue somewhat elastic is needed. Hence this should be bought of parties supplying book-binding materials.

Finely broken glue may be had, and will be found most convenient. When heated the glue should be about as thin as thin maple syrup. If the lower part of the glue-pot be kept well filled with water, the glue, once heated, will keep its heat the longer. A brass or iron rod should be kept standing in the glue-pot. This will be found convenient for pressing out of the brush the excess of glue each time before using it.

If the pot is kept only a third or fourth full, its sides soon become loaded with glue; whereas, if the pot is kept half or two-thirds full, most of this will dissolve.

As the water evaporates, add more. If the glue gets too thin add more glue. Glue does not work well when hot, because it dries too fast. Children are almost sure to use too much glue.

PASTE should be thick. First attempts usually result in its being too thin. In making paste it is of chief importance to have a batter, like thick cream, *free from lumps*. This is best obtained by the use of warm water.

Hence to make paste, place a pint of water on the stove. By the time you have measured out four heaping tablespoonfuls of

* See page 22. † See page 177.

flour (nearly a pint) the water is warm enough for making the batter. By the time the batter is ready the remainder of the water is boiling. Into this slowly pour the batter, and stir till the paste looks the same throughout (about a minute).

Paste should be used from a low pan or cup. Otherwise from the smeared sides of the pail, the handles of the brushes soon become unpleasant to take hold of. I find the cast-off school drinking cups make satisfactory paste cups.

At the close of the day, the cups and brushes should be washed out. This is made easy by allowing the cups to stand full of water till the dried portions of paste soak soft. In using paste children are apt to use the brush too lightly. Their mistaken remedy for this is to use too much paste. Another fault quite as general and as mischievous, is their skipping of spots, especially along the edges of a paper they are covering with paste.

By reason of the children's interest the work divides itself into two parts. The second and third grade children like to mend the torn leaves with the strips. They do not seem to tire of this work. Older children find it tedious. But they like the work of mending loose backs, making new covers, and rebinding, the very work the little ones are not able to do. The character of the work done by the little ones is good. Being careful to do just as directed, their mending is neat and otherwise satisfactory.

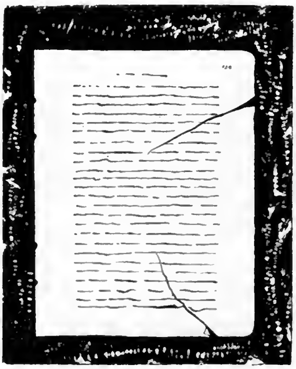


FIG. 1.

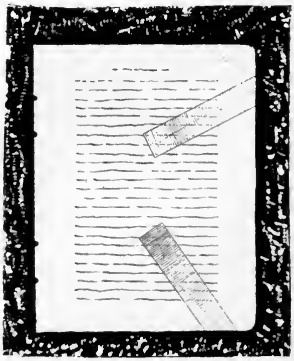


FIG. 2.

To teach the little ones HOW TO MEND TORN LEAVES AND EDGES was always to us both a lark.

Not more than a single class, of twenty or twenty-five, should be taught at once. Each pupil is to select from his desk a book, in which he is to find a leaf to be mended.

Standing before them I do some mending. Thus they quickly get an idea of what they are to do, and how they are to do it.

I show them the two kinds of strips, and explain that for places torn into the print the tissue strips are used, because even though they cover up the print we can read through them. See Figs. 1 and 2. In this first lesson the work is entirely confined to the mending with tissue paper.

With the brush I give a part of our pasting-board (with us a piece of tin) a coating of paste; I then cut over this a few tissue strips into different lengths. These fall upon the pasted surface and are then carefully smoothed out, so that the paste comes into contact with every part of their under surface. Having selected a torn leaf from the many offered, I peel off the tin a tissue strip of the right length. The torn edges are brought carefully together, and are then neatly covered by the strip. A piece of paper at hand for the purpose, is laid over the strip. This is rubbed with a firm pressue till the strip is so smooth and transparent that it scarcely shows. That the strips look clean and fresh when dry, the fingers should touch them as little as possible.. A piece of paper kept for the purpose should always intervene.

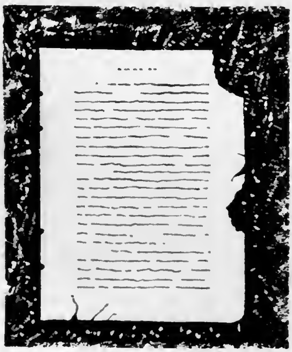


Fig. 3.

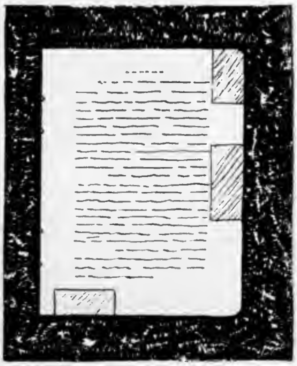


Fig. 4.

Next, each pupil is ready to try his own hand at the work.

I give the tin a new coating of paste, and more strips, smoothe them down into the paste, and pass these around among the pupils according to their needs. They select their strips according to the places to be mended, and as they peel them off, I direct how to use them. The work moves on with spirit, the demand for slips being greater than the supply. The dismissing gong sounds, but even that does not stop the work.

One lesson suffices for this part of the work. The next one, conducted in the same way, teaches how to mend mutilated edges with the strong opaque strips, Figs. 3 and 4. In this, the precautions for neatness are the same. The strips must be pressed and rubbed till perfectly smooth, but always with the intervening paper. The edge of the strip must be brought *exactly* to the edge of the leaf. A book, like a boy, *neatly* patched is perfectly respectable—and slovenly patched always meets with disapproval.

If strips dry on the tin before they can be used, and refuse to peel off, brush them over with paste. In a minute or two, from the absorbed moisture, they will come off readily.

Sometimes a piece of the leaf is gone. If this be covered with a pasted strip, a piece of paper must be inserted below to prevent the paste's going to the lower leaf.

Replacing loose leaves can scarcely be done by weak hands.

Fig. 5.

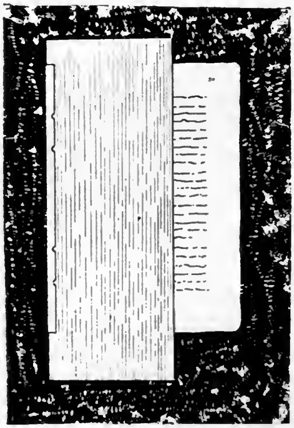


Fig. 6.

The difficulty is to push the leaf as far into the back as it was originally, so that its edges will not stick out beyond the rest.

The best device I found for this, was a piece of Russia iron, Figs. 5 and 6. It should be longer than the leaf, and wide enough to be easily manipulated. Place one edge of the iron on the loose leaf within one-eighth or one-twelfth of an inch of the edge to be pasted (the inner edge). With the leaf and iron held together, fold them over together, flat upon the table. Thus the projecting edge is turned under. Run your thumb along this edge to crease it.

Take it up and apply paste sparingly to this little folded edge. By means of the sheet iron insert the leaf to its place, pushing it down into the back till its edges are even with those of the book.

Two adjacent loose leaves should be fastened together by a strip, and then by the sheet iron pushed down into the back where they belong. Where there are several loose adjacent leaves, they should be built into a section, sewed, pasted and pushed down into the back.

Sometimes it is justifiable, instead of building up a section by pasting opposite leaves together, to sew them together by neatly overcasting their inner edges. Care must be used not to take the stitches deeply into the margin as this would prevent the leaves opening properly.

Loose leaves where margins have been mended must dry under pressure, otherwise they will be very much out of shape when dry.

To put in an "insheet" so improves the appearance of an old book that it pays, especially as the cost is but the fraction of a cent. Those who can, should learn to do this by seeing it done, and then by doing it under supervision.

The insheet is the double blank sheet, next to the cover, one-half of it being pasted to the cover, the other half free. They should be cut a trifle large and trimmed to exact size after being fastened in place. Cut and fold in the middle. Paste a narrow streak on the edge of the fold, and press this folded edge well up under the edge of the cover; close the cover and let dry while you fix the opposite one. When the insheet is dry, so that it is well fastened, trim it with a *knife;* trim the lower one first, by inserting under it a piece of pasteboard to cut into, and above it the brass ruler as a guide for the knife, the ruler being placed exactly even with the edges of the book.

To paste the outer sheet to the cover apply paste to the paper and close the lid down over it, pressing thoroughly. When the lid is lifted the insheet comes with it, and the work is done.

Examine several books to see how the insheets have been put in.

This and the following work was taught in the office to one or two at a time, as other work permitted. When I found one with a special aptitude for the work I made of him a teacher for the guidance of others.

What to do for a book with A LOOSE BACK is puzzling to an amateur. Each case has to be treated on its own merits. The best training for this kind of surgery is to carefully examine some new books along with some old and loose ones. This brings you face to face with the commonplace fact that the book is held to its cover by glue. If the cover is loose the glue has given way somewhere. But how to get at the place? The brush can't be poked into the middle of the back from one end. To effect the needed remedy you have to cut down far enough to lay bare the weakness. One side of the cover must be entirely detached from the book. This enables you to get at both sides freely. By running a sharp knife along the edge of the cloth, easily seen under the paper, about an inch from the edge of the cover, the cloth which comes off with the book will peel from the cover with a straight edge and can be as neatly glued in place again.

By carefully examining a few books some will be found with the back proper free from the back of the book and others free in no particular, but tightly glued to the back of the book throughout. In mending a book follow the plan upon which it was made.

A loose back being a trifle too large for a tight back, if made into the latter will distress the mender with its wrinkles.

To give a paper bound book a board cover, it must be understood that the back must bend where the leaves bend. Hence, give a pupil two books for study: one that has been sewed, and one that has been fastened with staples. Show him how much closer the lids come to the back in one case than in the other. If you can have him work out why this is, there will be a saving for him of many mistakes, and for you of much explaining and directing.

If it is not plain to you, you can easily make it so by the two experiments of fastening the cover an inch above, and then an inch below the staples, noting how this cover opens in each case.

Whenever a straight, smooth edge is required of paper or board, do the cutting with the knife, not the scissors. Use a brass ruler as a guide for the knife. In cutting board don't feel that it must be done by one stroke of the knife. Be sure only that the knife follows the same track each time. However lightly the pressure, the knife will in time make its way through. Don't press so hard that a few minutes' use of the knife will cause blisters. Make of cutting, not hard, but easy work.

Rebinding a book proceeds thus: The cover is made; it is fastened to the book; it is then covered, and finally receives its insheets.

To get the back on the book squarely, keep it straight with the edge of the table as you work.

The correct distance between the lids of the covers, as they lie to receive the cloth-back, is a very important measurement. To get it, wrap closely around the back of the book, a piece of paper. Clamp this firmly to the sides of the book by the lids in their proper place. Run a pencil along the back edges of the boards where they come to the paper, and you have your measure.

Lay this on the table so that when the boards are laid to the marks they will be straight with the edge of the table. To make the work easy for the children's hands, fasten the boards thus in proper position, by small clamps to the table. Then they will not get out of square in gluing. The cloth-back should be longer than the cover, to allow of folding over at each end. Its width depends on how wide a strip of cloth you like to see on the back of your book. Lay the cloth-back where it belongs on the boards and mark, that you may know how wide a strip on your boards to glue for it. Use the glue very sparingly, but thoroughly, that your cloth does not get mussy and pulled. Never, if avoidable, apply paste or glue to material that will "strike through" quickly. Always use protecting sheets to confine the glue exactly to the strips where it is needed.

While the cover thus made is drying, cut a similar piece of cloth, but shorter than the book, to be glued to the back of it.

Before doing this, remove all old glue and loose shreds. This is best done by alternately pounding and scraping the back. When clean, apply glue, driving the brush hard so as to force the glue well in between the sections. Place the glued back in the middle of the strip of cloth prepared for it, and by pressing and rubbing, bring every part of the cloth down into the glue, being especially careful to have the cloth adhere strongly at the edges. To ensure the last, let the book dry in press. In press, the back should project free from the pressing boards; but the free cloth edges should be held down by the pressing boards, tightly against the edges of the back.

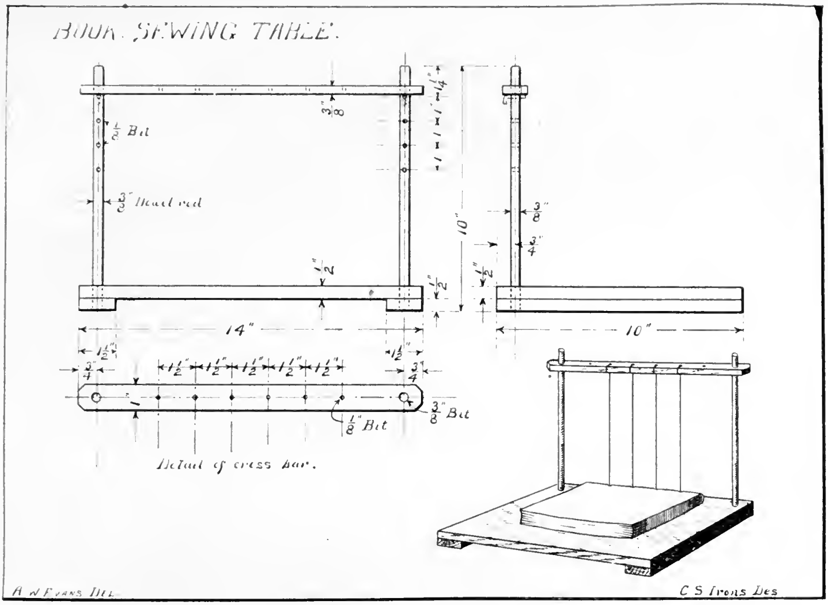
When dry, the book may be placed within the cover. In doing this, the only parts to receive glue, are strips on the inner parts of the boards which the free cloth edges belonging to the back of the book mark for their own. Mark how far out the cloth edges come; with protecting sheet apply glue, and bring the surfaces together by closing down the lid of the book. In doing this, have the book pressed well back into the cover equally distant from each end. With the thumb crease down the cloth at the edge of the board, so that every part of the cloth of the back and the cover shall be thoroughly glued together and utilized for strength.

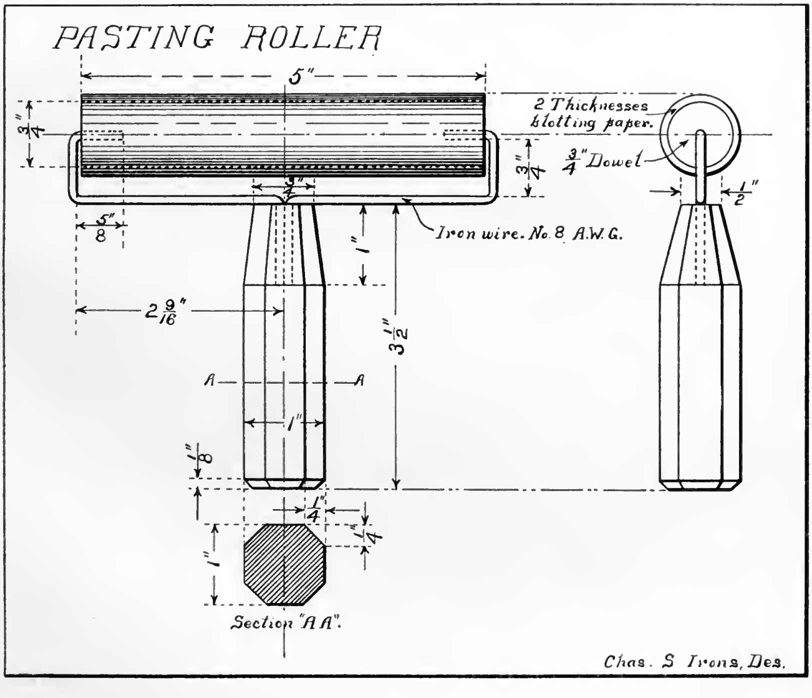
When finished, the book should dry in press. If the glue has been used sparingly, it may be taken from press in a few hours. Otherwise it should remain there over night. To avoid surfaces sticking together that should not, protecting sheets should be inserted freely.

To PUT ON THE MARBLE PAPER use paste, applying this to the paper. A careful examination of a book bound in boards will render further directions needless, except that the corners will be puzzling till they are cut off with the shears within a third of an inch of the corner of the board. These are cut off more conveniently after the paper has been pasted to the board, when ready to turn the edges.

When the book has been covered with marble paper, it is ready for its insheets.

Only the cheapest materials have been used in our work; hence nothing has been said of what the work would be with any other.


BOOK SEWING TABLE.
A W Evans Del.
C S Irons Des.
Detail of cross bar.
14"
10"
10"
1/2 Bit
3/8 Bit
1/8 Bit
3/8" Head rod


PASTING ROLLER
5"
2 Thicknesses blotting paper.
3/4" Dowel
Iron wire. No. 8 A.W.G.
2 9/16"
3 1/2"
A—
—A
Section "AA".
Chas. S Irons, Des.

DESCRIPTION OF THE IMPORTANT WOODS OF THE UNITED STATES.

[ARRANGED ALPHABETICALLY.]

A.—CONIFEROUS WOODS.

Woods of simple and uniform structure, generally light, soft but stiff; abundant in suitable dimensions and forming by far the greatest part of all the lumber used.

CEDAR—Light, soft, stiff, not strong, of fine texture; sap and heartwood distinct, the former lighter, the latter a dull, grayish brown, or red. The wood seasons rapidly, shrinks and checks but little, and is very durable. Used like soft pine, but owing to its great durability preferred for shingles, etc. Small sizes used for posts, ties, etc.* Cedars usually occur scattered, but they form, in certain localities, forests of considerable extent.

a. WHITE CEDARS.—Heartwood a light grayish brown.

1. WHITE CEDAR (*Thuya occidentalis*) (Arborvitæ): Scattered along streams and lakes, frequently covering extensive swamps; rarely large enough for lumber, but commonly used for posts, ties, etc. Maine to Minnesota and northward.
2. CANOE CEDAR (*Thuya gigantea*) (red cedar of the West): In Oregon and Washington a very large tree, covering extensive swamps; in the mountains much smaller, skirting the water courses; an important lumber tree. Washington to northern California and eastward to Montana.
3. WHITE CEDAR (*Chamæcyparis thyoides*): Medium-sized tree, wood very light and soft. Along the coast from Maine to Mississippi.
4. WHITE CEDAR (*Chamæcyparis lawsoniana*) (Port Oxford cedar, Oregon cedar, Lawson's cypress, ginger pine): A very large tree, extensively cut for lumber; heavier and stronger than the preceding. Along the coast line of Oregon.

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* Since almost all kinds of woods are used for fuel and charcoal, and in the construction of fences, sheds, barns, etc., the enumeration of these uses has been omitted in this list.

5. White cedar (*Libocedrus decurrens*) (incense cedar): A large tree, abundantly scattered among pine and fir; wood fine grained. Cascades and Sierra Nevada of Oregon and California.

b. Red Cedars.—Heartwood red.

6. Red cedar (*Juniperus virginiana*) (Savin juniper): Similar to white cedar, but of somewhat finer texture. Used in cabinetwork in cooperage, for veneers, and especially for lead pencils, for which purpose alone several million feet are cut each year. A small to medium sized tree scattered through the forests, or, in the West, sparsely covering extensive areas (cedar brakes). The red cedar is the most widely distributed conifer of the United States, occurring from the Atlantic to the Pacific and from Florida to Minnesota, but attains a suitable size for lumber only in the Southern, and more especially the Gulf, States.

7. Redwood (*Sequoia sempervirens*): Wood in its quality and uses like white cedar; the narrow sapwood whitish; the heartwood light red, soon turning to brownish red when exposed. A very large tree, limited to the coast ranges of California, and forming considerable forests, which are rapidly being converted into lumber.

CYPRESS.

8. Cypress (*Taxodium distichum*) (bald cypress; black, white, and red cypress): Wood in appearance, quality, and uses similar to white cedar. "Black cypress" and "white cypress" are heavy and light forms of the same species. The cypress is a large deciduous tree occupying much of the swamp and overflow land along the coast and rivers of the Southern States.

FIR.—This name is frequently applied to wood and to trees which are not fir; most commonly to spruce, but also, especially in English markets, to pine. It resembles spruce, but is easily distinguished from it, as well as from pine and larch, by the absence of resin ducts. Quality, uses, and habits similar to spruce.

9. Balsam fir (*Abies balsamea*): A medium-sized tree scat-

tered throughout the northern pineries; cut, in lumber operations, whenever of sufficient size, and sold with pine or spruce. Minnesota to Maine and northward.

10. WHITE FIR (*Abies grandis* and *Abies concolor*): Medium to very large sized tree, forming an important part of most of the Western mountain forests, and furnishing much of the lumber of the respective regions. The former occurs from Vancouver to central California and eastward to Montana; the latter from Oregon to Arizona and eastward to Colorado and New Mexico.

11. WHITE FIR (*Abies amabilis*): Good-sized tree often forming extensive mountain forests. Cascade Mountains of Washington and Oregon.

12. RED FIR (*Abies nobilis*) (not to be confounded with Douglas fir; see No. 37): Large to very large tree, forming with *A. amabilis* extensive forests on the slope of the mountains between 3,000 and 4,000 feet elevation. Cascade Mountains of Oregon.

13. RED FIR (*Abies magnifica*): Very large tree, forming forests about the base of Mount Shasta. Sierra Nevada of California, from Mount Shasta southward.

HEMLOCK.—Light to medium weight, soft, stiff, but brittle, commonly crossgrained, rough and splintery; sapwood and heartwood not well defined; the wood of a light reddish-gray color, free from resin ducts, moderately durable, shrinks and warps considerably, wears rough, retains nails firmly. Used principally for dimension stuff and timbers. Hemlocks are medium to large sized trees, commonly scattered among broad-leaved trees and conifers, but often forming forests of almost pure growth.

14. HEMLOCK (*Tsuga canadensis*): Medium-sized tree, furnishes almost all the hemlock of the Eastern market. Maine to Wisconsin; also following the Alleghanies southward to Georgia and Alabama.

15. HEMLOCK (*Tsuga mertensiana*): Large-sized tree, wood claimed to be heavier and harder than the eastern form and of superior quality. Washington to California and eastward to Montana.

LARCH OR TAMARACK.—Wood like the best of hard pine, both in appearance, quality, and uses, and owing to its great durability, somewhat preferred in ship building, for telegraph poles, and railroad ties. In its structure it resembles spruce. The larches are deciduous trees, occasionally covering considerable areas, but usually scattered among other conifers.

16. TAMARACK (*Larix americana*) (Hackmatack): Medium-sized tree, often covering swamps, in which case it is smaller and of poor quality. Maine to Minnesota and southward to Pennsylvania.

17. TAMARACK (*L. occidentalis*): Large-sized trees, scattered, locally abundant. Washington and Oregon to Montana.

PINE.—Very variable, very light and soft in "soft" pine, such as white pine; of medium weight to heavy and quite hard in "hard" pine, of which longleaf or Georgia pine is the extreme form. Usually it is stiff, quite strong, of even texture, and more or less resinous. The sapwood is yellowish white; the heartwood, orange brown. Pine shrinks moderately, seasons rapidly and without much injury; it works easily; is never too hard to nail (unlike oak or hickory); it is mostly quite durable, and if well seasoned is not subject to the attacks of boring insects. The heavier the wood, the darker, stronger, and harder it is, and the more it shrinks and checks. Pine is used more extensively than any other kind of wood. It is the principal wood in common carpentry, as well as in all heavy construction, bridges, trestles, etc. It is also used in almost every other wood industry, for spars, masts, planks, and timbers in shipbuilding, in car and wagon construction, in cooperage, for crates and boxes, in furniture work, for toys and patterns, railway ties, water pipes, excelsior, etc. Pines are usually large trees with few branches, the straight, cylindrical, useful stem forming by far the greatest part of the tree; they occur gregariously, forming vast forests, a fact which greatly facilitates their exploitation. Of the many special terms applied to pine as lumber, denoting sometimes differences in quality, the following deserve attention:

"White pine," "pumpkin pine," "soft pine," in the Eastern markets refer to the wood of the white pine (*Pinus strobus*) and on the Pacific coast to that of the sugar pine (*Pinus lambertiana*).

"Yellow pine" is applied in the trade to all the Southern lumber pines; in the Northeast it is also applied to the pitch pine (*P. rigida*); in the West it refers mostly to bull pine (*P. ponderosa*).

"Yellow longleaf pine," "Georgia pine," chiefly used in advertisement, refers to longleaf pine (*P. palustris*).

"Hard pine" is a common term in carpentry, and applies to everything except white pine.

"Pitch pine" includes all Southern pines and also the true pitch pine (*P. rigida*), but is mostly applied, especially in foreign markets, to the wood of the longleaf pine (*P. palustris*).

For the great variety of confusing local names applied to the Southern pines in their homes, part of which have been adopted in the markets of the Atlantic seaboard, see report of Chief of Division of Forestry for 1891, page 212, etc., and also the list below:

a. Soft Pines.

18. White pine (*Pinus strobus*): Large to very large sized tree; for the last fifty years the most important timber tree of the Union, furnishing the best quality of soft pine. Minnesota, Wisconsin, Michigan, New England, along the Alleghanies to Georgia.

19. Sugar pine (*Pinus lambertiana*): A very large tree, together with *Abies concolor*, forming extensive forests; important lumber tree. Oregon and California.

20. White pine (*Pinus monticola*): A large tree, at home in Montana, Idaho, and the Pacific States; most common and locally used in Northern Idaho.

21. White pine (*Pinus flexilis*): A small tree, forming mountain forests of considerable extent and locally used; Eastern Rocky Mountain slopes; Montana to New Mexico.

b. Hard Pines.

22. Longleaf pine (*Pinus palustris*) (Georgia pine, yellow pine, long straw pine, etc.): Large tree; forms extensive for-

ests and furnishes the hardest and strongest pine lumber in the market. Coast region from North Carolina to Texas.

23. Bull pine (*Pinus ponderosa*) (yellow pine): Medium to very large sized tree, forming extensive forests in Pacific and Rocky Mountain regions; furnishes most of the hard pine of the West; sapwood wide; wood very variable.

24. Loblolly pine (*Pinus tæda*) (slash pine, old field pine, rosemary pine, sap pine, short straw pine, etc.): Large-sized tree, forms extensive forests; wider ringed, coarser, lighter, softer, with more sapwood than the longleaf pine, but the two often confounded. This is the common lumber pine from Virginia to South Carolina, and is found extensively in Arkansas and Texas. Southern States; Virginia to Texas and Arkansas.

25. Norway pine (*Pinus resinosa*): Large-sized tree, never forming forests, usually scattered or in small groves, together with white pine; largely sapwood and hence not durable. Minnesota to Michigan; also in New England to Pennsylvania.

26. Shortleaf pine (*Pinus echinata*) (slash pine, Carolina pine, yellow pine, old field pine, etc.): Resembles loblolly pine; often approaches in its wood the Norway pine. The common lumber pine of Missouri and Arkansas. North Carolina to Texas and Missouri.

27. Cuban pine (*Pinus Cubensis*) (slash pine, swamp pine, bastard pine, meadow pine): Resembles longleaf pine, but commonly has wider sapwood and coarser grain; does not enter the markets to any great extent. Along the coast from South Carolina to Louisiana.

28. Bull pine (*Pinus jeffreyi*) (black pine): Large-sized tree, wood resembling bull pine (*P. ponderosa*); used locally in California, replacing *P. ponderosa* at high altitudes.

The following are small to medium sized pines, not commonly offered as lumber in the market; used locally for timber, ties, etc.:

29. Black pine (*Pinus murrayana*) (lodge-pole pine, tamarack): Rocky Mountains and Pacific regions.

30. Pitch pine (*Pinus rigida*): Along the coast from New York to Georgia and along the mountains to Kentucky.

31. Jersey pine (*Pinus inops*) (scrub pine): As before.

32. GRAY PINE (*Pinus banksiana*) (scrub pine): Maine, Vermont, and Michigan to Minnesota.

REDWOOD. (*See* CEDAR.)

SPRUCE.—Resembles soft pine, is light, very soft, stiff, moderately strong, less resinous than pine; has no distinct heartwood, and is of whitish color. Used like soft pine, but also employed as resonance wood and preferred for paper pulp. Spruces, like pines, form extensive forests; they are more frugal, thrive on thinner soils, and bear more shade, but usually require a more humid climate. "Black" and "white spruce," as applied by lumbermen, usually refer to narrow and wide ringed forms of the black spruce (*Picea nigra*).

33. BLACK SPRUCE (*Picea nigra*): Medium-sized tree, forms extensive forests in northeastern United States and in British America; occurs scattered or in groves, especially in low lands throughout the Northern pineries. Important lumber tree in Eastern United States. Maine to Minnesota, British America, and on the Alleghanies to North Carolina.

34. WHITE SPRUCE (*Picea alba*): Generally associated with the preceding; most abundant along streams and lakes, grows largest in Montana and forms the most important tree of the subarctic forest of British America. Northern United States, from Maine to Minnesota, also from Montana to Pacific, British America.

35. WHITE SPRUCE (*Picea engelmanni*): Medium to large-sized tree, forming extensive forests at elevations from 5,000 to 10,000 feet above sea level; resembles the preceding, but ccupies a different station. A very important timber tree in the central and Southern parts of the Rocky Mountains. Rocky Mountains from Mexico to Montana.

36. TIDE-LAND SPRUCE (*Picea sitchensis*): A large-sized tree, forming an extensive coast-belt forest. Along the seacoast from Alaska to Central California.

BASTARD SPRUCE.—Spruce or fir in name but resembling hard pine or larch in the appearance, quality, and uses of its wood.

37. DOUGLAS SPRUCE (*Pseudotsuga douglasii*) (yellow fir, red

fir, Oregon pine): One of the most important trees of the Western United States; grows very large in the Pacific States, to fair size in all parts of the mountains, in Colorado up to about 10,000 feet above sea level; forms extensive forests, often of pure growth. Wood very variable, usually coarse-grained and heavy, with very pronounced summer wood, hard and strong ("red" fir), but often fine-grained and light ("yellow" fir). It replaces hard pine and is especially suited to heavy construction. From the plains to the Pacific Ocean; from Mexico to British America.

TAMARACK. (*See* LARCH.)

YEW.—Wood heavy, hard, extremely stiff and strong, of fine texture with a pale yellow sapwood, and an orange red heart; seasons well and is quite durable. Yew is extensively used for archery, bows, turner's ware, etc. The yews form no forests, but occur scattered with other conifers.

38. YEW (*Taxus brevifolia*): A small to medium-sized tree of the Pacific region.

B.—BROAD-LEAVED WOODS (HARDWOODS).

Woods of complex and very variable structure and therefore differing widely in quality, behavior, and consequently in applicability to the arts.

ASH.—Wood heavy, hard, strong, stiff, quite tough, not durable, in contact with soil, straight grained, rough on the split surface and coarse in texture. The wood shrinks moderately, seasons with little injury, stands well and takes a good polish. In carpentry ash is used for finishing lumber, stairways, panels, etc.; it is used in shipbuilding, in the construction of cars, wagons, carriages, etc., in the manufacture of farm implements, machinery, and especially of furniture of all kinds, and also for harness work; for barrels, baskets, oars, tool handles, hoops, clothespins, and toys. The trees of the several species of ash are rapid growers, of small to medium height with stout trunks; they form no forests, but occur scattered in almost all our broad-leaved forests.

39. WHITE ASH (*Fraxinus americana*): Medium, sometimes

large sized tree. Basin of the Ohio, but found from Maine to Minnesota and Texas.

40. RED ASH (*Fraxinus pubescens*): Small-sized tree. North Atlantic States, but extends to the Mississippi.

41. BLACK ASH (*Fraxinus sambucifolia*) (hoop ash, ground ash): Medium-sized tree, very common. Maine to Minnesota, and southward to Virginia and Arkansas.

42. BLUE ASH (*Fraxinus quadrangulata*): Small to medium sized. Indiana and Illinois; occurs from Michigan to Minnesota and southward to Alabama.

43. GREEN ASH (*Fraxinus viridis*) Small-sized tree. New York to the Rocky Mountains, and southward to Florida and Arizona.

44. OREGON ASH (*Fraxinus oregana*): Medium-sized tree. Western Washington to California.

ASPEN. (*See* POPLAR.)

BASSWOOD.

45. BASSWOOD (*Tilia americana*) (lime tree, American linden, lin, bee tree): Wood light, soft, stiff but not strong, of fine texture, and white to light brown color. The wood shrinks considerably in drying, works and stands well; it is used in carpentry, in the manufacture of furniture and woodenware, both turned and carved, in cooperage, for toys, also for paneling of car and carriage bodies. Medium to large-sized tree, common in all Northern broad-leaved forests; found throughout the Eastern United States.

46. WHITE BASSWOOD (*Tilia heterophylla*): A small-sized tree most abundant in the Alleghany region.

BEECH.

47. BEECH (*Fagus ferruginea*): Wood heavy, hard, stiff, strong, of rather coarse texture, white to light brown, not durable in the ground, and subject to the inroads of boring insects; it shrinks and checks considerably in drying, works and stands well and takes a good polish. Used for furniture, in turnery, for handles, lasts, etc. Abroad it is very extensively employed by the carpenter, millwright, and wagon maker, in turnery as well as wood carving. The beech is a medium-

sized tree, common, sometimes forming forest; most abundant in the Ohio and Mississippi basin, but found from Maine to Wisconsin and southward to Florida.

BIRCH.—Wood heavy, hard, strong, of fine texture; sapwood whitish, heartwood in shades of brown with red and yellow; very handsome, with satiny luster, equaling cherry. The wood shrinks considerably in drying, works and stands well and takes a good polish, but is not durable, if exposed. Birch is used for finishing lumber in building, in the manufacture of furniture, in wood turning, for spools, boxes, wooden shoes, etc., for shoe lasts and pegs, for wagon hubs, ox yokes, etc., also in wood carving. The birches are medium-sized trees, form extensive forests northward and occur scattered in all broad-leaved forests of the Eastern United States.

48. CHERRY BIRCH (*Betula lenta*) (black birch, sweet birch, mahogany birch): Medium-sized tree; very common. Maine to Michigan and to Tennessee.

49. YELLOW BIRCH (*Betula lutea*) (gray birch): Medium-sized tree; common. Maine to Minnesota and southward to Tennessee.

50. RED BIRCH (*Betula nigra*) (river birch): Small to medium-sized tree; very common; lighter and less valuable than the preceding. New England to Texas and Missouri.

51. CANOE BIRCH (*Betula papyrifera*) (white birch, paper birch): Generally a small tree; common, forming forests; wood of good quality but lighter. All along the northern boundary of United States and northward, from the Atlantic to the Pacific.

BLACK WALNUT. (*See* WALNUT.)

BLUE BEECH.

52. BLUE BEECH (*Carpinus caroliniana*) (hornbeam, water beech, ironwood): Wood very heavy, hard, strong, very stiff, of rather fine texture and white color; not durable in the ground; shrinks and checks greatly, but works and stands well. Used chiefly in turnery for tool handles, etc. Abroad, much used by mill and wheel-wrights. A small tree, largest in the Southwest, but found in nearly all parts of the Eastern United States.

BOIS D'ARC. (*See* OSAGE ORANGE.)

BUCKEYE—HORSE CHESTNUT.—Wood light, soft, not strong, often quite tough, of fine and uniform texture and creamy white color. It shrinks considerably, but works and stands well. Used for wooden ware, artificial limbs, paper pulp, and locally also for building lumber. Small-sized trees, scattered.

53. OHIO BUCKEYE (*Æsculus glabra*) (fetid buckeye): Alleghanies, Pennsylvania to Indian Territory.

54. SWEET BUCKEYE (*Æsculus flava*): Alleghanies, Pennsylvania to Texas.

BUTTERNUT.

55. BUTTERNUT (*Juglans cinerea*) (white walnut): Wood very similar to black walnut, but light, quite soft, not strong and of light brown color. Used chiefly for finishing lumber, cabinetwork, and cooperage. Medium-sized tree, largest and most common in the Ohio basin; Maine to Minnesota and southward to Georgia and Alabama.

CATALPA.

56. CATALPA (*Catalpa speciosa*): Wood light, soft, not strong, brittle, durable, of coarse texture and brown color; used for ties and posts, but well suited for a great variety of uses. Medium-sized tree; lower basin of the Ohio River, locally common. Extensively planted, and therefore promising to become of some importance.

CHERRY.

57. CHERRY (*Prunus serotina*): Wood heavy, hard, strong, of fine texture; sapwood yellowish white, heartwood reddish to brown. The wood shrinks considerably in drying, works and stands well, takes a good polish, and is much esteemed for its beauty. Cherry is chiefly used as a decorative finishing lumber for buildings, cars, and boats, also for furniture and in turnery. It is becoming too costly for many purposes for which it is naturally well suited. The lumber-furnishing cherry of this country, the wild black cherry (*prunus serotina*), is a small to medium-sized tree, scattered through many of

the broad-leaved woods of the western slope of the Alleghanies, but found from Michigan to Florida and west to Texas. Other species of this genus as well as the hawthorns (*Cratægus*) and wild apple (*Pyrus*) are not commonly offered in the market. Their wood is of the same character as cherry, often even finer, but in small dimensions.

CHESTNUT.

58. CHESTNUT (*Castanea vulgaris* var. *americana*): Wood light, moderately soft, stiff, not strong, of coarse texture; the sapwood light, the heartwood darker brown. It shrinks and checks considerably in drying, works easily, stands well, and is very durable. Used in cabinetwork, cooperage, for railway ties, telegraph poles, and locally in heavy construction. Medium-sized tree, very common in the Alleghanies, occurs from Maine to Michigan and southward to Alabama.

59. CHINQUAPIN (*Castanea pumila*): A small-sized tree, with wood slightly heavier but otherwise similar to the preceding; most common in Arkansas, but with nearly the same range as the chestnut.

60. CHINQUAPIN (*Castanopsis chrysophylla*): A medium-sized tree of the western ranges of California and Oregon.

COFFEE TREE.

61. COFFEE TREE (*Gymnocladus canadensis*) (coffee nut): Wood heavy, hard, strong, very stiff, of coarse texture, durable; the sapwood yellow, the heartwood reddish brown; shrinks and checks considerably in drying; works and stands well and takes a good polish. It is used to a limited extent in cabinetwork. A medium to large sized tree; not common. Pennsylvania to Minnesota and Arkansas.

COTTONWOOD. (*See* POPLAR.)

CUCUMBER TREE. (*See* TULIP.)

ELM.—Wood heavy, hard, strong, very tough; moderately durable in contact with the soil; commonly crossgrained, difficult to split and shape, warps, and checks considerably in drying, but stands well if properly handled. The broad sapwood whitish, heart brown, both with shades of gray and red; on split surface rough; texture coarse to fine; capable of high polish. Elm is used in the construction of cars, wagons, etc., in boat and ship building, for agricultural implements and machinery; in rough cooperage, saddlery and harness work, but particularly in the manufacture of all kinds of furniture, where the beautiful figures, especially those of the tangential or bastard section, are just beginning to be duly appreciated. The elms are medium to large sized trees, of fairly rapid growth, with stout trunk, form no forests of pure growth, but are found scattered in all the broad-leaved woods of our country, sometimes forming a considerable portion of the arborescent growth.

62. WHITE ELM (*Ulmus americana*) (American elm, water elm): Medium to large sized tree, common. Maine to Minnesota, southward to Florida and Texas.

63. ROCK ELM (*Ulmus racemosa*) (cork elm, hickory elm, white elm, cliff elm): Medium to large sized tree. Michigan, Ohio, from Vermont to Iowa, southward to Kentucky.

64. RED ELM (*Ulmus fulva*) (slippery elm, moose elm): Small-sized tree, found chiefly along water courses. New York to Minnesota, and southward to Florida and Texas.

65. CEDAR ELM (*Ulmus crassifolia*): Small-sized tree, quite common. Arkansas and Texas.

66. WINGED ELM (*Ulmus alata*) (Wahoo): Small-sized tree, locally quite common. Arkansas, Missouri, and eastern Virginia.

GUM.—This general term refers to two kinds of wood usually distinguished as sweet or red gum, and sour, black, or tupelo gum, the former being a relative of the witch-hazel, the latter belonging to the dogwood family.

67. TUPELO (*Nyssa sylvatica*) (sour gum, black gum): Maine to Michigan, and southward to Florida and Texas. Wood heavy, hard, strong, tough, of fine texture, frequently cross-grained, of yellowish or grayish white color, hard to split and work, troublesome in seasoning, warps and checks considerably, and is not durable if exposed; used for wagon hubs, wooden ware, handles, wooden shoes, etc. Medium to large

sized trees, with straight, clear trunks; locally quite abundant, but never forming forests of pure growth.

68. TUPELO GUM (*Nyssa uniflora*) (cotton gum): Lower Mississippi basin, northward to Illinois and eastward to Virginia, otherwise like preceding species.

69. SWEET GUM (*Liquidambar styraciflua*) (red gum, liquidambar, bilsted): Wood rather heavy, rather soft, quite stiff and strong, tough, commonly crossgrained, of fine texture; the broad sapwood whitish, the heartwood reddish brown; the wood shrinks and warps considerably, but does not check badly, stands well when fully seasoned, and takes good polish. Sweet gum is used in carpentry, in the manufacture of furniture, for cut veneer, for wooden plates, plaques, baskets, etc., also for wagon hubs, hat blocks, etc. A large-sized tree, very abundant, often the principal tree in the swampy parts of the bottoms of the Lower Mississippi Valley; occurs from New York to Texas and from Indiana to Florida.

HACKBERRY.

70. HACKBERRY (*Celtis occidentalis*) (sugar berry): The handsome wood heavy, hard, strong, quite tough, of moderately fine texture, and greenish or yellowish white color; shrinks moderately, works well, and takes a good polish. So far but little used in the manufacture of furniture. Medium to large sized tree, locally quite common, largest in the Lower Mississippi Valley; occurs in nearly all parts of the Eastern United States.

HICKORY.—Wood very heavy, hard, and strong, proverbially tough, of rather coarse texture, smooth and of straight grain. The broad sapwood white, the heart reddish nut brown. It dries slowly, shrinks and checks considerably; is not durable in the ground, or if exposed, and, especially the sapwood, is always subject to the inroads of boring insects. Hickory excels as carriage and wagon stock, but is also extensively used in the manufacture of implements and machinery, for tool handles, timber pins, for harness work, and cooperage. The hickories are tall trees with slender stems, never form forests, occasionally small groves, but usually occur scattered among other broad-leaved trees in suitable localities. The following species all contribute more or less to hickory of the markets:

71. Shagbark hickory (*Hicoria ovata*) (shellbark hickory): A medium to large sized tree, quite common; the favorite among hickories; best developed in the Ohio and Mississippi basins; from Lake Ontario to Texas, Minnesota to Florida.

72. Mockernut hickory (*Hicoria alba*) (black hickory, bull and black nut, big bud, and white-heart hickory): A medium to large sized tree, with the same range as the foregoing; common, especially in the South.

73. Pignut hickory (*Hicoria glabra*) (brown hickory, black hickory, switch-bud hickory): Medium to large sized tree, abundant; all Eastern United States.

74. Bitter nut hickory (*Hicoria minima*) (swamp hickory): A medium-sized tree, favoring wet localities, with the same range as the preceding.

75. Pecan (*Hicoria pecan*) (Illinois nut): A large tree, very common in the fertile bottoms of the Western streams. Indiana to Nebraska and southward to Louisiana and Texas.

HOLLY.

76. Holly (*Ilex opaca*): Wood of medium weight, hard, strong, tough, of fine texture and white color; works and stands well, used for cabinet work and turnery. A small tree, most abundant in the Lower Mississippi Valley and Gulf States, but occurring eastward to Massachusetts and north to Indiana.

HORSE CHESTNUT. (*See* Buckeye.)

IRONWOOD. (*See* Blue beech.)

LOCUST.—This name applies to both of the following:

77. Black locust (*Robinia pseudacacia*) (black locust, yellow locust): Wood very heavy, hard, strong, and tough, of coarse texture, very durable in contact with the soil, shrinks considerably and suffers in seasoning; the very narrow sapwood yellowish, the heartwood brown, with shades of red and green. Used for wagon hubs, tree nails or pins, but especially for ties, posts, etc. Abroad it is much used for furniture and farm implements and also in turnery. Small to medium sized

tree, at home in the Alleghanies, extensively planted, especially in the West.

78. Honey locust (*Gleditschia triacanthos*) (black locust, sweet locust, three-thorned acacia): Wood heavy, hard, strong, tough, of coarse texture, susceptible of a good polish, the narrow sapwood yellow, the heartwood brownish red. So far, but little appreciated except for fencing and fuel; used to some extent for wagon hubs and in rough construction. A medium-sized tree, found from Pennsylvania to Nebraska, and southward to Florida and Texas; locally quite abundant.

MAGNOLIA. (*See* Tulip.)

MAPLE.—Wood heavy, hard, strong, stiff, and tough, of fine texture, frequently wavy-grained, this giving rise to "curly" and "blister" figures; not durable in the ground or otherwise exposed. Maple is creamy white, with shades of light brown in the heart; shrinks moderately, seasons, works and stands well, wears smoothly, and takes a fine polish. The wood is used for ceiling, flooring, paneling, stairway, and other finishing lumber in house, ship, and car construction; it is used for the keels of boats and ships, in the manufacture of implements and machinery, but especially for furniture, where entire chamber sets of maple rival those of oak. Maple is also used for shoe lasts and other form blocks, for shoe pegs, for piano actions, school apparatus, for wood type in show bill printing, tool handles, in wood carving, turnery, and scroll work. The maples are medium-sized trees, of fairly rapid growth; sometimes form forests and frequently constitute a large proportion of the arborescent growth.

79. Sugar Maple (*Acer saccharum*) (hard maple, rock maple): Medium to large sized tree, very common, forms considerable forests. Maine to Minnesota, abundant, with birch, in parts of the pineries; southward to northern Florida; most abundant in the region of the Great Lakes.

80. Red maple (*Acer rubrum*) (swamp or water maple): Medium-sized tree. Like the preceding, but scattered along water courses and other moist localities.

81. Silver maple (*Acer saccharinum*) (soft maple, silver

maple): Medium-sized, common; wood lighter, softer, inferior to hard maple, and usually offered in small quantities and held separate in the market. Valley of the Ohio, but occurs from Maine to Dakota and southward to Florida.

82. BROAD LEAFED MAPLE (*Acer macrophyllum*): Medium-sized, forms considerable forests, and like the preceding has a lighter, softer, and less valuable wood. Pacific Coast.

MULBERRY.

83. RED MULBERRY (*Morus rubra*): Wood moderately heavy, hard, strong, rather tough, of coarse texture, durable; sapwood whitish, heart yellow to orange brown; shrinks and checks considerably in drying; works and stands well. Used in cooperage and locally in shipbuilding and in the manufacture of farm implements. A small-sized tree, common in the Ohio and Mississippi valleys, but widely distributed in the Eastern United States.

OAK.—Wood very variable, usually very heavy and hard, very strong and tough, porous, and of coarse texture; the sapwood whitish, the heart "oak" brown to reddish brown. It shrinks and checks badly, giving trouble in seasoning, but stands well, is durable, and little subject to attacks of insects. Oak is used for many purposes: in shipbuilding, for heavy construction, in common carpentry, in furniture, car, and wagon work, cooperage, turnery, and even in wood carving; also in the manufacture of all kinds of farm implements, wooden mill machinery, for piles and wharves, railway ties, etc. The oaks are medium to large sized trees, forming the predominant part of a large portion of our broad-leaved forests, so that these are generally "oak forests" though they always contain a considerable proportion of other kinds of trees. Three well-marked kinds, white, red and live oak, are distinguished and kept separate in the market. Of the two principal kinds white oak is the stronger, tougher, less porous and more durable. Red oak is usually of coarser texture, more porous, often brittle, less durable, and even more troublesome in seasoning than white oak. In carpentry and furniture work red oak brings about the same price at present as white oak. The red oaks everywhere accompany the white oaks, and, like the latter, are usually represented by several species in any given locality. Live oak, once largely employed in ship-building, possesses all the good qualities (except that of size) of white oak, even to a greater degree. It is one of the heaviest, hardest, and most durable building timbers of this country; in structure it resembles the red oaks, but is much less porous.

84. White oak (*Quercus alba*): Medium to large sized tree; common in the Eastern States, Ohio and Mississippi valleys; occurs throughout Eastern United States.

85. Bur oak (*Quercus macrocarpa*) (mossy-cup oak, over-cup oak): Large-sized tree, locally abundant, common. Bottoms west of Mississippi; range farther west than preceding.

86. Swamp white oak (*Quercus bicolor*): Large-sized tree, common. Most abundant in the Lake States, but with range as in white oak.

87. Yellow oak (*Quercus prinoides*) (chestnut oak, chinquapin oak): Medium-sized tree; Southern Alleghanies, eastward to Massachusetts.

88. Basket oak (*Quercus michauxii*) (cow oak): Large-sized tree; locally abundant; lower Mississippi and eastward to Delaware.

89. Over-cup oak (*Quercus lyrata*) (swamp white oak, swamp post oak): Medium to large sized tree; rather restricted; ranges as in the preceding.

90. Post oak (*Quercus obtusiloba*) (iron oak): Medium to large sized tree. Arkansas to Texas, eastward to New England and northward to Michigan.

91. White oak (*Quercus durandii*): Medium to small sized tree. Texas, eastward to Alabama.

92. White oak (*Quercus garryana*): Medium to large-sized tree. Washington to California.

93. White oak (*Quercus lobata*): Medium to large-sized tree; largest oak on the Pacific coast; California.

94. Red oak (*Quercus rubra*) (black oak): Medium to large-sized tree; common in all parts of its range. Maine to Minnesota, and southward to the Gulf.

95. Black oak (*Quercus tinctoria*) (yellow oak): Medium to large sized tree, very common in the Southern States, but occurring north as far as Minnesota, and Eastward to Maine.

96. Spanish oak (*Quercus falcata*) (red oak): Medium sized tree, common in the South Atlantic and Gulf region, but found from Texas to New York, and north to Missouri and Kentucky.

97. Scarlet oak (*Quercus coccinea*): Medium to large-sized tree; best developed in the lower basin of the Ohio, but found from Maine to Missouri, and from Minnesota to Florida.

98. Pin oak (*Quercus palustris*) (swamp spanish oak, water oak): Medium to large sized tree, common along borders of streams and swamps. Arkansas to Wisconsin, and eastward to the Alleghanies.

99. Willow oak (*Quercus phellos*) (peach oak): Small to medium sized tree. New York to Texas, and northward to Kentucky.

100. Water oak (*Quercus aquatica*) (duck oak, possum oak, punk oak): Medium to large sized tree, of extremely rapid growth. Eastern Gulf States, eastward to Delaware, and northward to Missouri and Kentucky.

101. Live oak (*Quercus virens*): Small sized tree, scattered along the coast from Virginia to Texas.

102. Live oak (*Quercus chrysolepis*) (maul oak, Valparaiso oak): Medium sized tree; California.

OSAGE ORANGE.

103. Osage orange (*Maclura aurantiaca*) (Bois d'Arc): Wood very heavy, exceedingly hard, strong, not tough, of moderately coarse texture, and very durable; sapwood yellow, heart brown on the end, yellow on longitudinal faces, soon turning grayish brown if exposed; it shrinks considerably in drying, but once dry it stands unusually well. Formerly much used for wheel stock in the dry regions of Texas; otherwise employed for posts, railway ties, etc. Seems too little appreciated; it is well suited for turned ware and especially for wood carving. A small sized tree, of fairly rapid growth, scattered through the rich bottoms of Arkansas and Texas.

PERSIMMON.

104. Persimmon (*Diospyros virginiana*): Wood very heavy and hard, strong and tough; resembles hickory, but is of finer

texture; the broad sapwood cream color, the heart black; used in turnery for shuttles, plane stocks, shoe lasts, etc. Small to medium sized tree, common and best developed in the Lower Ohio Valley, but occurs from New York to Texas and Missouri.

POPLAR AND COTTONWOOD (*See also* TULIP WOOD).—Wood light, very soft, not strong, of fine texture and whitish, grayish to yellowish color, usually with a satiny luster. The wood shrinks moderately (some crossgrained forms warp excessively), but checks little; is easily worked, but is not durable. Used as building and furniture lumber, in cooperage for sugar and flour barrels, for crates and boxes (especially cracker boxes), for wooden ware and paper pulp.

105. COTTONWOOD (*Populus monilifera*): Large sized tree; forms considerable forests along many of the Western streams, and furnishes most of the cottonwood of the market. Mississippi Valley and west; New England to the Rocky Mountains.

106. BALSAM (*Populus balsamifera*) (balm of Gilead): Medium to large sized tree; common all along the northern boundary of the United States.

107. BLACK COTTONWOOD (*Populus trichocarpa*): The largest deciduous tree of Washington; very common. Northern Rocky Mountains and Pacific region.

108. COTTONWOOD (*Populus fremontii* var. *wislizeni*): Medium to large sized tree, common. Texas to California.

109. POPLAR (*Populus grandidentata*): Medium sized tree, chiefly used for pulp. Maine to Minnesota and southward along the Alleghanies.

110. ASPEN (*Populus tremuloides*): Small to medium sized tree, often forming extensive forests and covering burned areas. Maine to Washington and northward, south in the Western mountains to California and New Mexico.

SOUR GUM. (*See* GUM.)

RED GUM. (*See* GUM.)

SASSAFRAS.

111. SASSAFRAS (*Sassafras sassafras*): Wood light, soft; not strong, brittle, of coarse texture, durable; sapwood yellow,

heart orange brown. Used in cooperage, for skiffs, fencing, etc. Medium sized tree, largest in the Lower Mississippi Valley, from New England to Texas and from Michigan to Florida.

SWEET GUM. (*See* GUM.)

SYCAMORE.

112. SYCAMORE (*Platanus occidentalis*) (button wood, button-ball tree, water beech): Wood moderately heavy, quite hard, stiff, strong, tough, usually crossgrained, of coarse texture, and white to light brown color; the wood is hard to split and work, shrinks moderately, warps and checks considerably, but stands well. It is used extensively for drawers, backs, bottoms, etc., in cabinet-making, for tobacco boxes, in cooperage, and also for finishing lumber, where it has too long been underrated. A large tree of rapid growth, common and largest in the Ohio and Mississippi valleys, at home in nearly all parts of the Eastern United States. The California species—

113. *Platanus racemosa* resembles in its wood the Eastern form.

TULIP WOOD.

114. TULIP TREE (*Liriodendron tulipifera*) (yellow poplar, white wood): Wood quite variable in weight, usually light, soft, stiff but not strong, of fine texture, and yellowish color; the wood shrinks considerably, but seasons without much injury; works and stands remarkably well. Used for siding, for paneling and finishing lumber in house, car, and ship building, for sideboards and panels of wagons and carriages; also in the manufacture of furniture, implements and machinery, for pump logs, and almost every kind of common wooden ware, boxes, shelving, drawers, etc. An ideal wood for the carver and toy man. A large tree, does not form forests, but is quite common, especially in the Ohio Basin; occurs from New England to Missouri and southward to Florida.

115. CUCUMBER TREE (*Magnolia acuminata*): A medium-sized tree, most common in the Southern Alleghanies, but distributed from New York to Arkansas, southward to Alabama and

northward to Illinois. Resembling, and probably confounded with, tulip wood in the markets.

TUPELO. (*See* Gum.)

WALNUT.

116. Black walnut (*Juglans nigra*): Wood heavy, hard, strong, of coarse texture; the narrow sapwood whitish, the heartwood chocolate brown. The wood shrinks moderately in drying, works and stands well, takes a good polish, is quite handsome, and has been for a long time the favorite cabinet wood in this country. Walnut, formerly used even for fencing, has become too costly for ordinary uses, and is to-day employed largely as a veneer, for inside finish and cabinet-work; also in turnery, for gunstocks, etc. Black walnut is a large tree, with stout trunk, of rapid growth, and was formerly quite abundant throughout the Alleghany region, occurring from New England to Texas, and from Michigan to Florida.

WHITE WALNUT. (*See* Butternut.)

WHITE WOOD. (*See* Tulip, and also Basswood.)

YELLOW POPLAR. (*See* Tulip.)

INSTRUCTION ON TOOLS.

ARRANGED BY MR. GRANT BEEBE, FROM NOTES BY THE AUTHOR.

After the pupils have been assigned to their benches it is desirable that they should clearly understand just what is expected of them in the matter of conduct. On account of the novelty of their surroundings in the shop, many pupils are likely to be disorderly, who would not be so, if they knew what was expected of them. The following suggestions have been found of value in overcoming this difficulty. They may either be given orally by the teacher or in case a note book is kept they should be the first entry made. In that case they should be dictated by the instructor.

1. Remain at the bench assigned to you always, unless given permission to leave it.

2. When you come into the shop you should go to your bench and stand at the middle of it facing the teacher while he reads the names of the members of the class.

Answer to your own name when it is read.

3. After the names are read you should inspect your bench and tools. See that you have all the tools and that they are in the proper places. If any tool is broken or missing you should let the teacher know at once. If you do not do so you will be held responsible. You should also see that all the tools that you are going to use are sharp. If they are not report to the teacher.

4. When you have looked over your tools you will receive your work, but you are not to begin work until told to do so.

5. Never do any talking or communicating in the shop unless you receive permission to do so.

6. When you need to use glue, shellac, or varnish go to the table or shelf to do so. Each can is labeled so that you can tell what is in it. Be careful to put the brushes into the same can in which you found them.

7. In case any tool does not work well and you can not fix it, let the teacher know at once.

Having given the preceding instructions let the pupils at once familiarize themselves with the bench and tools. The first object that will attract their attention is the vise. Explain its action and show how to open and close it *quietly*. If this is insisted upon at first much trouble will be avoided. After the vise take up the tools in order calling attention to the place where each is kept. If possible get the pupils to give the names of the tools. If not tell them the names. Too much stress can not be laid on this point as it is impossible to give instructions unless the pupils have the names of the tools fixed in their minds.

Having let the pupils become familiar with the tools and the places where they are kept some slight instruction should be given on the material to be used. It is not desirable to give extended instruction at this point but the name of the kind of wood used should be given and the meaning of the word *grain* clearly defined as suggested below.

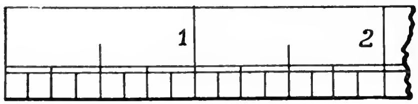
WOOD.

NOTE.—The kind of wood used is white pine (or whatever wood is employed.) It belongs to the class known as soft woods. The *grain* of wood is due to the direction in which the fibres grow in the tree. Wood always splits in the direction of the grain.

Directions.—The teacher should illustrate this by splitting a small block or better provide each pupil with a block and let him investigate for himself.

THE RULER.

FIG. 1.



NOTE.—The carpenter's ruler is twenty-four inches long and each inch is divided either into eighths or sixteenths.

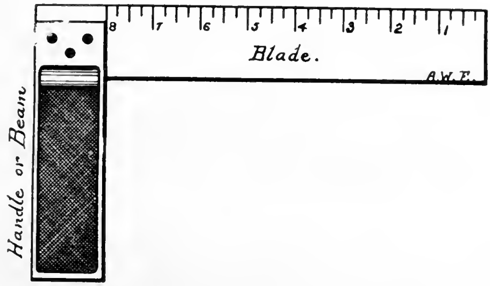
Directions.—The teacher should place on the blackboard a large sketch similar to Fig. 1, and should divide the inches before the class, who may compare with their rulers. Make clear the point that the ruler measures *spaces* and to make sure that this is understood ask questions such as: How many *lines* mark one inch?

two inches? three-eighths? etc. Also have pupils read from the blackboard drawing.

TRYSQUARE.

NOTE.—The square is used to determine whether two surfaces make a right angle (or an angle of 90°) with each other. The names of the parts of the square are given below.

FIG. 2



Directions.—Define a right angle and make sure that the pupil understands what an angle is. Make clear the difference between the geometrical square and use of the word in mechanics. Draw on the board a square and any other rectangle and show that in the sense that the word is used in the shop the rectangle is also "square."

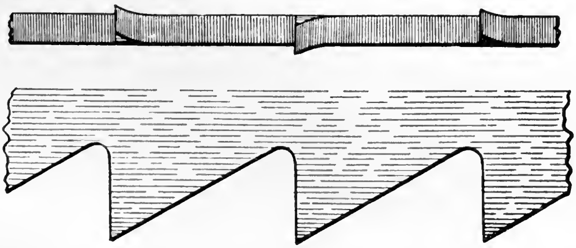
SAWS.

NOTE.—The shape of the teeth of a saw determines the use to which the saw is put.

RIP SAW.

NOTE.—The Rip Saw is used to cut in the direction of the grain. The shape of the teeth of the rip saw is given below.

FIG. 3

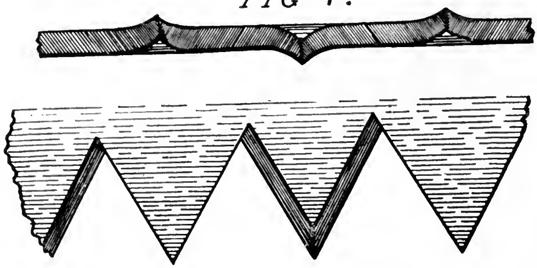


Directions.—The teacher should have a wooden model which has teeth not less than three inches on the front side and which the pupils can compare with the teeth on their rip saws. The model should show the set very plainly. The rip saw cuts as a chisel does and the teacher should illustrate with a chisel and saw, showing that the shaving from the chisel is similar to the particles of saw dust from the saw.

CROSS CUT SAW.

NOTE.—The Cross Cut Saw is used to cut across the grain. The teeth are shaped like this:

FIG 4.



The cross cut saw is sometimes called the panel saw.

Directions.—The teacher should illustrate with wooden model as before. If possible have the pupils draw the teeth on the blackboard from their own saws before showing them the model. This training of the faculty of observation is important. The action of the cross cut saw is that obtained by the use of a knife and chisel. The sharp edge of the tooth cuts the fibres and the upper part pushes them from the cut. Illustrate with knife and chisel.

Both saws are narrower at the point than at the handle to

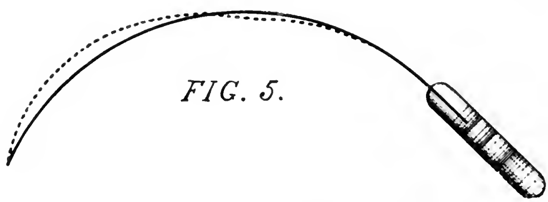


FIG. 5.

make them cut more near the handle than at the point. The narrow point also enables the user to straighten a crooked cut. (Illustrate.)

Note.—If a saw bends in an even curve from handle to point it shows that the blade is of uniform temper and evenly ground.

If the saw is poor it will bend unevenly as shown by the dotted line. A good saw should spring back into a straight line after being bent.

PRINCIPLES OF SAW CONSTRUCTION.

The saw is either reciprocating or continuous in action, the first being a flat blade and practically straight edge, making a plane cut, as in hand, mill, jig and sash saws; the latter, either a circular or rotating disc, cutting in a plane at a right angle to its axis, a cylindrical or barrel shape with a convex edge cutting parallel to its axis, or a continuous ribbon or band running on two pulleys making a plain or curved cut with a straight edge parallel to their axis of rotation. Practically speaking, the teeth are a series of knives set on a circular or straight line, each tooth cutting out its proportion of wood and kept from cutting more by the teeth on either side of it. Each tooth should cut the same amount and carry out the chip or dust, dropping it to the sides or below the material being sawed. Different kinds of wood require teeth different in number, angle or pitch and style of filing.

The most perfect saw is one that cuts the fastest and smoothest with the least expenditure of power; to do this, it is evident that each tooth should be so constructed and dressed as to do an equal proportion of the work, for if any of the teeth are out of line or shape, they are not only useless themselves, but a disadvantage to the others. We find many good mechanics who frankly acknowledge that they never could file a saw satisfactorily; the probable reason is that they never studied the principle of the action or working of the tool. There is no reason why any man of ordinary mechanical ability should not be able to put and keep his saw in order, but like all trades, it requires practice and study of the subject.

A careful study of the following illustrations and explanations is suggested.

A saw tooth has two functions—paring and scraping. A slitting or ripping saw for wood should have its cutting edge at about right angles to the fibre of the wood, severing it in *one* place, the throat of tooth wedging out the piece.

In a cross-cut wood saw, the cutting edge also strikes the fibre at right angles to its length, but severs it on *each side* from the main body before dislodging it.

RIP SAWS.

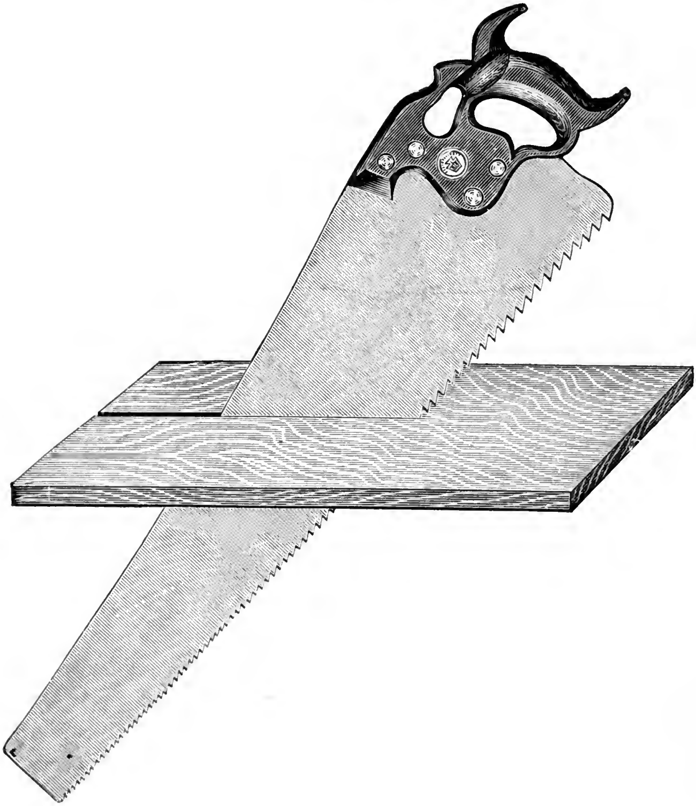


Fig. 7.

Fig. 8 is a four point rip or slitting saw with the rake all in front, where the cutting duty is. This saw should be filed square across, filing one-half the teeth from each side after setting, which will give a slight bevel to the cutting edge of the tooth, as it should be for soft wood; for medium hard woods a finer toothed saw with

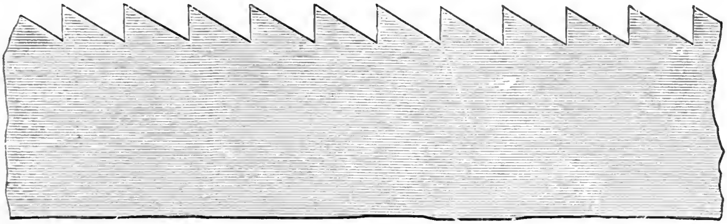


Fig. 8.

five points to the inch should be used and dressed in the same manner; for the very hardest and toughest cross-grained woods a saw still finer, the teeth filed slightly beveling, as ripping cross-grained stuff partakes a little of the nature of cross-cutting. In all cases where ripping is done, the thrust of the saw should be on an angle of about 45° to the material being cut, as shown in Fig. 7, this makes a shearing cut, an advantage that can be quickly demonstrated with an ordinary pocket knife cutting any piece of wood. For ripping thoroughly dry lumber, it will be found advantageous to use an extra thin back saw which will run without set.

CROSS-CUT HAND SAWS.

In cross-cutting, the fibre of the wood is severed *twice*—on each side of the saw—the thrust dislodging and carrying the dust out.

Fig. 9 is a five-point peg tooth cross-cut saw with the rake on the side. For the same reason that the rip saw has the rake on front of tooth, the cross-cut has it on the side, as that is where

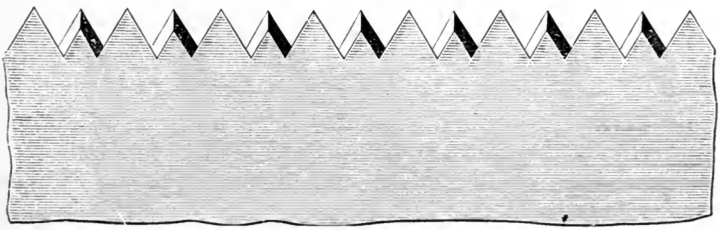


Fig. 9.

the cutting duty is. The bevel or fleam to teeth in Fig. 9 is about

45°, while there is no pitch at all; the angle on each side being the same, forms the *"peg tooth,"* which is best adapted to cutting soft, wet and fibrous woods, and used principally as a buck saw.

In all cases, the size and length of teeth depend largely upon the duty required; a long tooth has the demerit of being weak and liable to spring, but the merit of giving a greater clearance to the saw-dust. The throat space in front of each tooth must be large enough to contain the dust of that tooth from one stroke; the greater the feed, the deeper the dust chamber required, or, more teeth. When the teeth are fine, the shape of the throat is of special interest.

The first point to be observed in the selection of a saw is to see that it "hangs" right. Grasp it by the handle and hold it in position for working, to see if the handle fits the hand properly. These are points of great importance for comfort and utility. A handle should be symmetrical, and the lines as perfect as any drawing. Many handles are made of green wood; they soon shrink and become loose, the screws standing above the wood. An unseasoned handle is liable to warp and throw the saw out of shape. The next thing in order is to try the blade by springing it, seeing that it bends regularly and evenly from point to butt in proportion as the width and gauge of the saw varies. If the blade is too heavy in comparison to the teeth, the saw will never give satisfaction, because it will require more labor to use it; the thinner you can get a stiff saw the better; it makes less kerf and takes less muscle to drive it. This principle applies to the well-ground saw. There is less friction on a narrow true saw than on a wide one; you will get a smaller portion of blade, but you will save much unnecessary labor at a very little loss of the width.

See that it is well set and sharpened and has a good crowning breast; place it at a distance from you and get a proper light on it, by which you can see if there is any imperfection in grinding or hammering. We should invariably make a cut before purchasing a saw, even if we had to carry a board to the hardware store. Saws are set on a stake or small anvil with a hammer; a highly tempered saw takes three or four blows, as it is apt to break by attempting to set it with but one blow. This is a severe test, and no tooth ought to break afterwards in setting, nor will it, if the mechanic adopts the proper method. The saw that is easily filed and set is easily made dull. As a rule, saws are set more than is necessary, and if more attention was paid to keeping points of teeth well sharpened, any well-made saw would run with very little set, and there would be fewer broken ones. The principal trouble is that too many try to get part of the set out of the body of the plate, while the whole of the set should be on the teeth. Setting below the root of the tooth distorts and strains the saw-plate, which may cause a full-tempered cast-steel blade to crack and eventually break at this spot, and is always an injury to the saw, even if it does not crack or break.

The teeth of a hand-saw should be filed so true that, on holding it up to the eye and looking along its edge, it will show a central groove down which a fine needle will slide freely the entire length; this groove must be angular in shape and equal on each side, or the saw is not filed properly and will not run true.

FIG. 10.

FIG. 11.

FIG. 12.

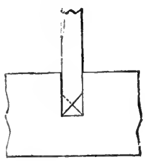


FIG. 13.

Fig 10 shows how the groove should appear on looking down the edge of the saw; the action should be such that the bottom of kerf will present the appearance as shown in Fig. 11, and not like Fig. 12; the cutting action is as shown in Fig. 13, the cutting being done with the outside of tooth, the fibre of the wood is severed in the two places and the wood is crumbled out from point to point by the thrust of saw.

The proper amount of bevel to give the teeth is very important, as is demonstrated by the above figures, for if too much bevel is given, the points will score so deeply that the fibres severed from the main body will not crumble out as severed, but be removed by continued rasping, particularly in hard woods, as they require less bevel, as well as pitch, than soft wood.

Fig. 14, shows a six-point cross-cut saw filed with a medium amount of bevel on front or face of tooth, and none on the back.

This tooth is used in buck saws, on hard wood, and for general sawing of woods of varying degrees of tenacity. This style of

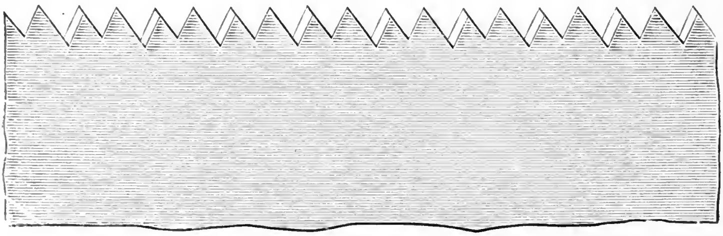


Fig. 14.

dressing is the best, but a number of saws each having teeth suited to its particular work, will be found more advantageous than trying to make one saw serve for all kinds of hand saw work.

We will now consider the cross-cut saw tooth, in regard to

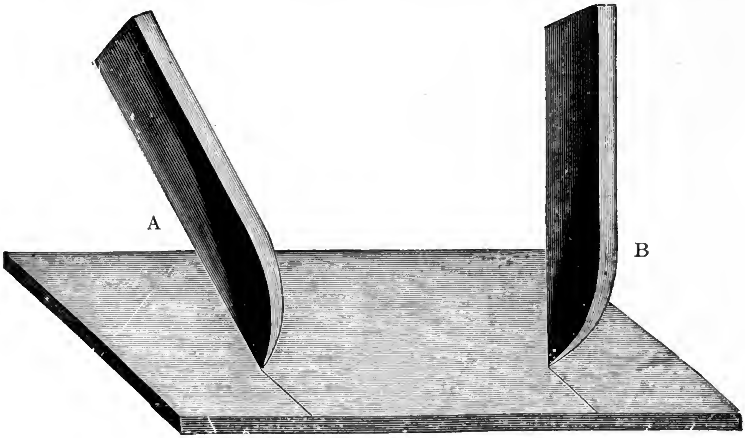
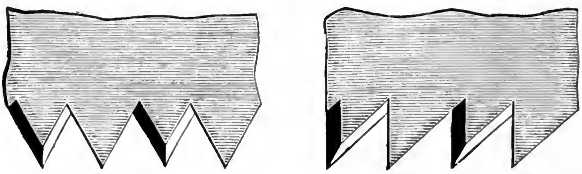


Fig. 15.



C. D.

rake or pitch; this being one of the most important features, too much care cannot be taken to have the correct amount of pitch for the duty required. To illustrate this Fig. 15 represents a board, across which we wish to make a deep mark or score with the point of a knife; suppose we hold the knife nearly perpendicular as at *B*, it is evident it will push harder and will not cut as smoothly as if it was inclined forward as at *A*; it follows then that the cutting edge of a cross-cut saw should incline forward as at *C*, rather than stand perpendicular as at *D*.

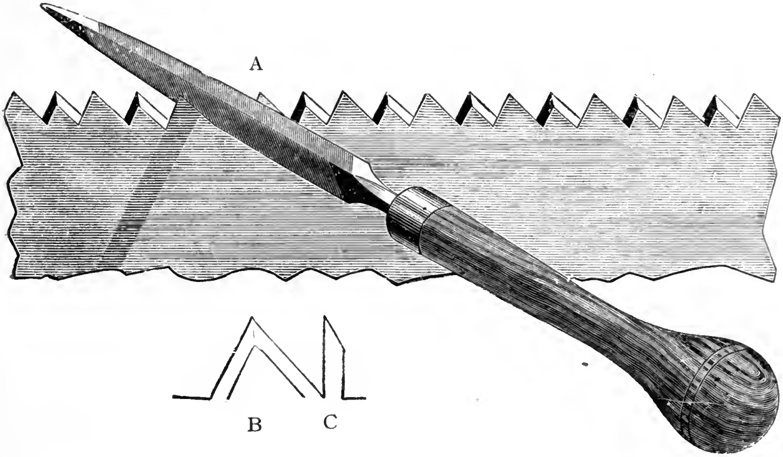


FIG. 16.

Too much hook or pitch, and too heavy a set are very common faults, not only detrimental to good work but ruinous to the saw; the first, by having a large amount of pitch, the saw takes hold so keenly that frequently it "*hangs up*" suddenly in the thrust—the result, a kinked or broken blade; the second, by having too much set, the strain caused by the additional and unnecessary amount of set is out of proportion to the strength of the blade, and is broken in the same manner. The most general amount of pitch used is 60°, though this may be varied a little more or less to advantage, as occasion may demand.

The next point to be considered is the bevel, or fleam of the point. In Figs. 16, 17 and 18, the filer, as in all cases, files from the heel to the point, which is the only correct way. The file is supposed to be horizontal to the perpendicular of the side of saw, and on an angle of about 45° longitudinally with the length, measuring from file line toward heel.

Fig. 16 is a five-and-a-half-point cross-cut saw showing the same amount of fleam front and back; this saw is best suited for

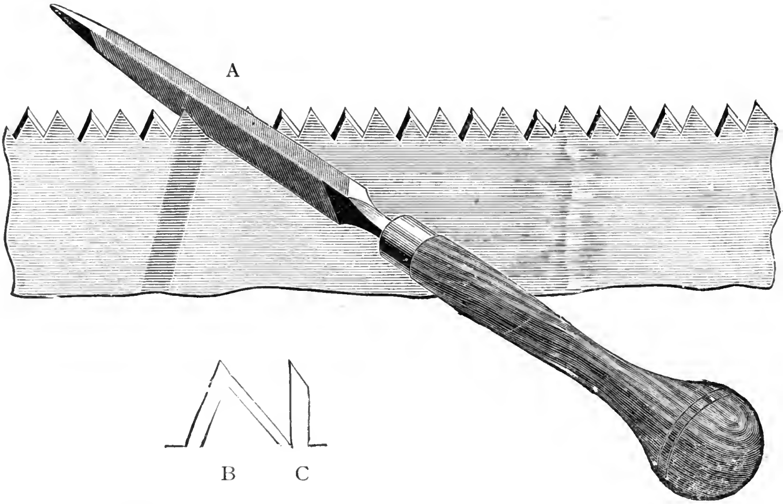


Fig. 17.

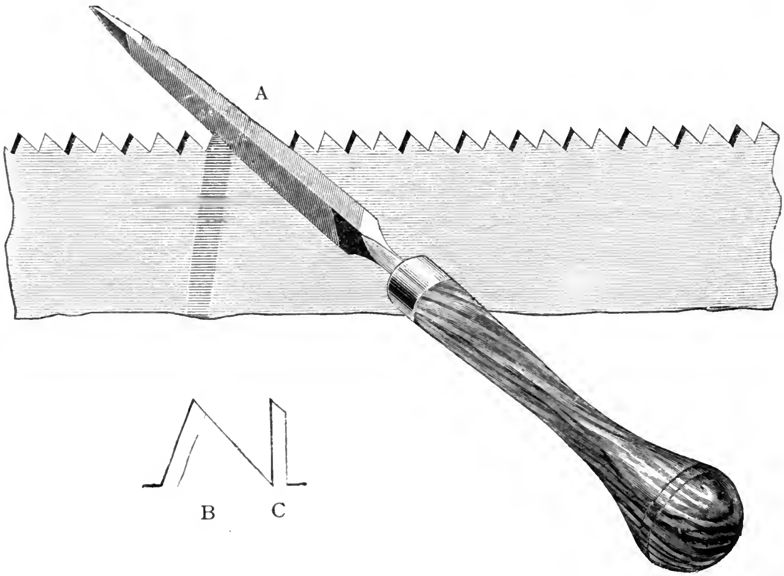


Fig. 18.

work in soft wood, and where rapid, rather than fine work is required. *A* shows the position of the file, *B* an exaggerated view of shape of point, and *C* the shape of point.

Fig. 17 is a seven-point saw for medium hard woods, illustrated in same manner as Fig. 10. This tooth has less fleam on the back, which gives a shorter bevel to point, as at *C*.

Fig. 18 is a still finer saw, having ten points to the inch. This saw has no fleam on back, the result being very noticeable at *C* and *B*. This style of point is for hard wood.

It will be seen that the bevel on the front of teeth in Figs. 16, 17 and 18 is the same, but the bevel of the point looking the length of saw is quite different, consequent upon the difference in the angles of the backs.

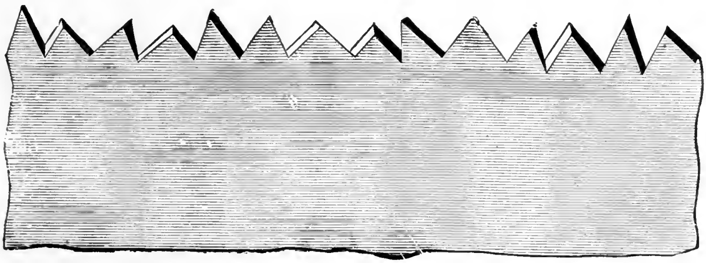


Fig 19.

Fig. 19 is a representation of some of the saws we have seen; there are entirely too many such now in use.

As we said in the preceding pages, and as will be seen by Figs. 16, 17 and 18, the filing should be done from the heel of saw toward the point. Many practical saw filers contend this is wrong, that the filing should be done from point of saw toward handle, but the only support they have for their theory is that they do away with the feather edge that the filing from the heel of saw puts on the cutting face of tooth. The feather edge is no objection, as the main part of it is removed when the teeth are side-dressed after filing. Against the correctness of filing from point to handle may be cited the following objections:

Where a different angle of back is required (it being remembered that angle of face should be the same in nearly all cross-cut hand saws, and that angle of back governs angle of point,) it will be found very difficult to obtain it without changing angle of face of tooth, and as the cutting duty is on the long side of face, any change is, of course, of great influence.

Again, to file from point of saw, it is necessary to file with the teeth bent toward the operator; this will cause the saw to vibrate or chatter, which not only renders good, clean, even filing impossible, but breaks the teeth of the file.

In the preceding illustrations, we have only given the coarser saws that are in most general use, but the same principle of filing should be applied to the finer toothed saws regarding angles and pitch suitable for woods of different degrees of hardness, the only actual difference being that one saw has finer points, and they being finer, require a little more care and delicate touch in setting and filing.

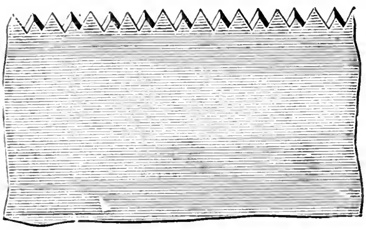


Fig. 20.

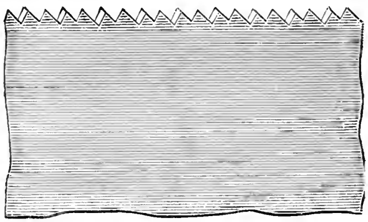


Fig. 21.

Fig. 20 is a section of an eleven-point saw suitable for the finer kinds of work on dry, soft woods, such as cutting mitres dove-tailing, pattern work, etc.

Fig. 21 shows a section of saw with same number of points as Fig. 20, but filed same as Fig. 18. This saw is for finer work, same as Fig. 20, only on the medium hard woods.

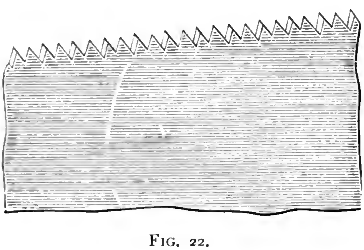


Fig. 22.

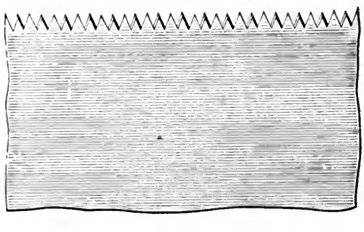


Fig. 23.

Fig. 22 is a still finer saw for fine work on the very hardest woods having the same dress as Fig. 20.

Fig. 23 is the finest toothed saw of its kind that is made for wood. All the above named saws in Figs. 20, 21, 22 and 23 are made especially hard and will not admit of setting, but being made thinner at the back, when properly filed, will cut clean and sweet. Teeth such as shown in Fig. 23 are used principally on back saws and smooth cutting hand-saws.

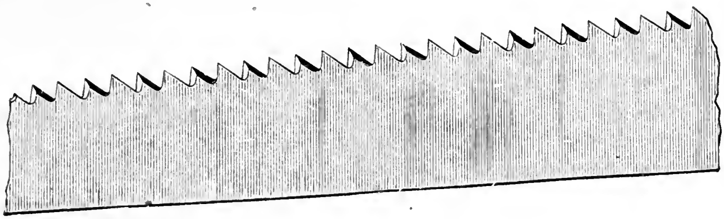


FIG. 24.

Fig. 24 is a section of a pruning saw which differs from a cross-cut hand-saw in being thicker, having a little more pitch to the teeth and being ground thinner on the back in proportion to its width. These, of course are made for cross-cutting only, as there is not a great variety in the work, nor as much difference in the woods to be sawed as to degrees of hardness, being used only as a pruning saw on fruit and shade trees, which are always practically green and comparatively soft.

COMPASS SAWS.

These saws are for miscellaneous sawing, having in turn, cross-cut, rip and mitre. The best form of tooth for this purpose is the same as Fig. 18, excepting that it has a trifle less bevel. As the nature of the work partakes about as much of cross-cutting as of ripping, and as a cross-cut saw will rip better than a rip will cross-cut, it is apparent the shape of tooth should be between the two. These saws are all ground thinner at back but set same as any hand-saw.

Scroll and web saws are ground, filed and set in the same manner, and should have pitch according to the work to be done. If more ripping than cross-cutting is done, as in large felloes, more pitch is given than in compass saws and *vice versa*, though these saws are almost universally run with a rip-saw tooth and have very little variation in the pitch.

NOTE.—The teeth of every saw are bent from side to side so that the cut will be wider than the thickness of the blade and the blade will pass easily through the cut. This bending is called the "Set".

BACK SAW.

NOTE.—The Back Saw is so called on account of the steel back put on it to stiffen the blade. It is sometimes called the tenon saw and is used for short fine cuts.

SETTING SAWS.

This is an important part of the work of keeping a saw in order and should always be done *after* the teeth are *jointed* and before filing. In all cases the set should be perfectly uniform, as the good working of the saw depends as much on this as on the filing. Whether the saw is fine or coarse, the depth of set should not go, at the most, lower than half the length of the tooth, as it is certain to spring the body of saw if not break the tooth out. Soft, wet woods require more set as well as coarser teeth than dry, hard woods. For fine work on dry woods, either hard or soft, it is best to have a saw that is ground so thin on the back that it requires no set; such saws are made hard and will not stand setting, and an attempt to do so would surely break the teeth.

PLANES.

NOTE.—The plane is generally used to make a flat, or plane surface. The names of the principal parts of the plane are given below.

The Clamp is to hold the blade and cap-iron in place.

The Cap-iron is to break off the shavings.

The Thumb Screw is to push the blade out or in.

The Lever is to bring the edge of the blade parallel with the face of the sole.

The Blade does the cutting and *must be kept sharp.*

Directions.—Have the pupils take their planes, (preferably the jack plane on account of its large size) and remove the clamp, blade and cap-iron. Give them the names of the stock and its parts as shown in the sketch. Let them see the operation of the lever and thumb screw. Call attention to the different materials

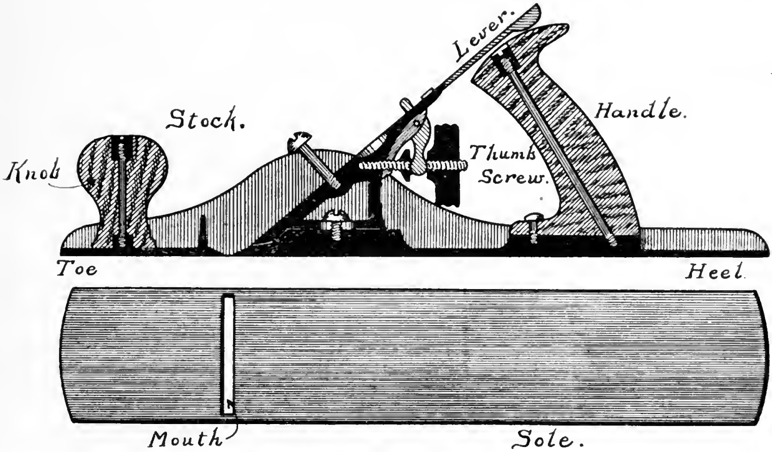


FIG. 25.

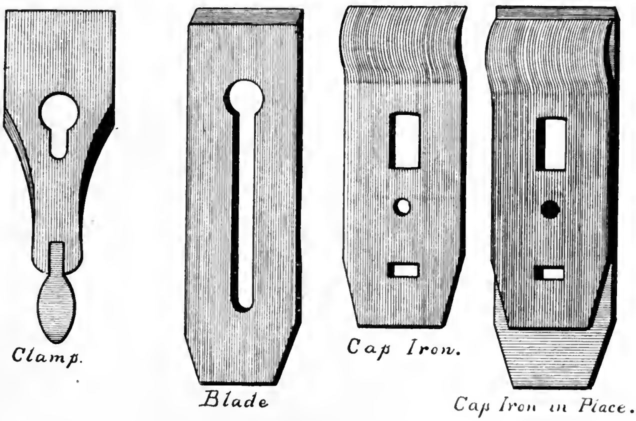


FIG. 26.

used in the stock and the reason for selecting them. It will not be possible in the majority of classes to have the sketch made from the plane, but Fig. 25 should be placed on the blackboard and the names put where they belong, a sketch should also be made showing the manner in which the cap-iron turns the shavings and breaks them off. In regard to the piece called the clamp there seems to be a difference of usage. I have adopted the word clamp because it prevents confusion and more nearly describes the action of the piece than any other single word. The cap-iron is universally called by this name but the blade is variously called the cutter, bit, plane iron, etc. I have adopted the word blade because it seems to convey the idea of the use of this piece more clearly than any other word. I object to the use of the words plane iron as being inaccurate and likely to confuse the pupil. Explain the difference between the wrought iron of which the cap is made and the steel of which the blade is made.

KINDS OF PLANES.

NOTE.—The most common planes are the Jack Plane and the Smoothing Plane. These are used to plane in the direction of the grain. There is a plane used for planing across the end of the grain. This plane is called the Block Plane, but the smoothing plane may be used for this purpose.

Directions.—The teacher should illustrate the different cuts with the plane and particularly the effect of planing against the grain.

NOTE.—The Jack Plane is made for rough work and so the blade is ground to take a thick shaving. The edge of a jack plane blade should round slightly like Fig. 27.

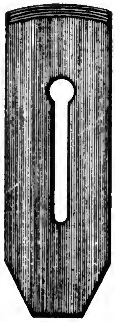


FIG. 27.

NOTE.—The Smoothing Plane is used to make a smooth surface. The blade is therefore ground straight across like Fig. 28.

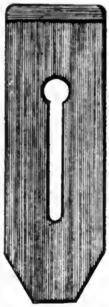


Fig. 28.

SHARPENING PLANES.

Note.—If the blade of a plane has its edge injured like Fig. 29 it

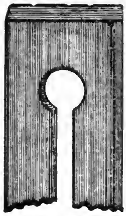


Fig. 29.

must be ground on the grindstone. The little notches in the blade are called "nicks" and the blade must be ground until they disappear. In placing the blade on the grindstone it must be held on the stone at an angle of about 30° as in Fig. 30.

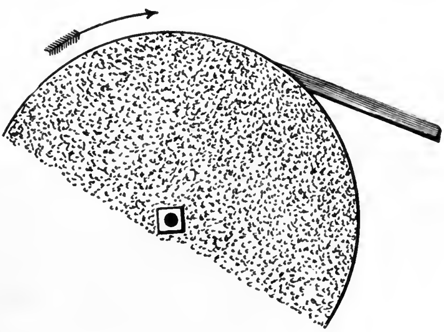


Fig. 30.

After grinding on the grindstone the edge of the blade is too rough to use and it must be rubbed on the oil-stone. First rub the newly ground or slanting face. To do this the blade must be held slanting as shown in Fig. 31.

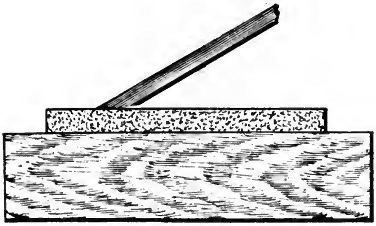


FIG. 31.

When the slanting side has been rubbed there will be little particles of steel forming a burr (called a wire edge) on the flat side. This burr must now be rubbed away and to do this the blade must be held flat as shown in Fig. 32.

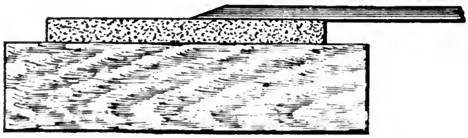


FIG. 32.

After the blade has been made as sharp as possible on the oil-stone it must be stropped on the block covered with leather provided for that purpose. (See page 247.)

BORING TOOLS.

NOTE.—The tools used for making holes are the brace and bit. The brace or bit-stock is shown below, Fig. 33.

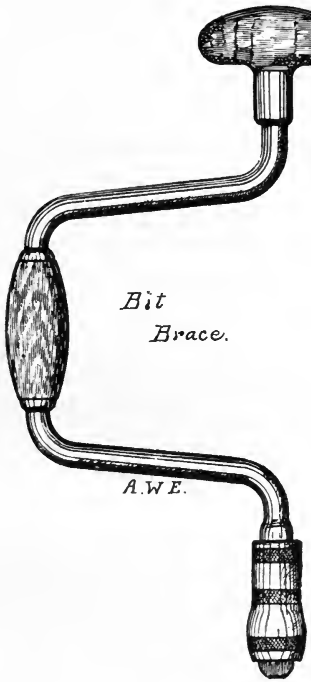


FIG. 33.

There are a large number of different kinds of bits used for various purposes, the most common of which are given below.

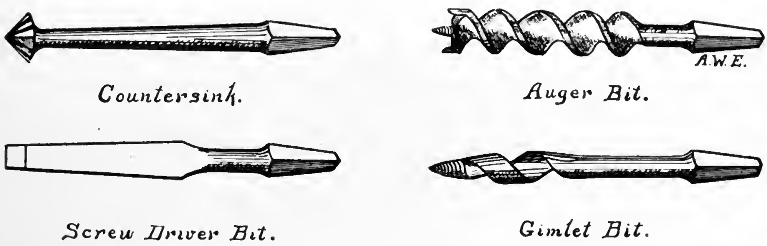


FIG. 34.

DIRECTIONS FOR SHARPENING AN AUGER BIT.

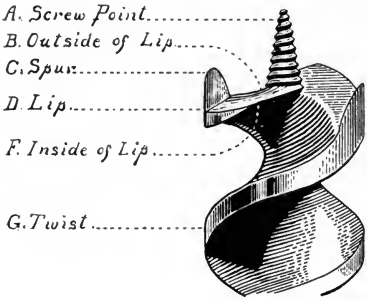


Fig. 1.

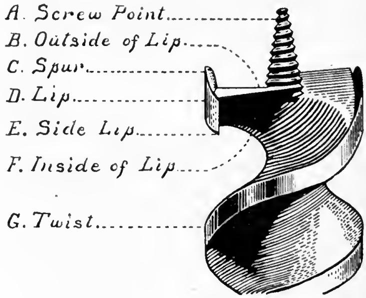


Fig. 2.

1. For sharpening an Auger Bit, a four inch, half round, dead-smooth file should be used.

2. To sharpen THE LIP, hold the Bit firmly in the left hand with the screw point down on edge of bench. Slant the Bit slightly to the left. File from the inside of the Lip, back, being careful to preserve the original bevel. File lightly until a slight burr, or feather edge, is thrown upon the outside of the Lip. Remove this burr by a slight brush of the file, and a keen cutting edge will be produced. Except for removing burr never use a file on the outside of the Lip.

If the Bit has a side Lip, (see Fig. 2 E) this is next sharpened by filing from the inside, care being taken to preserve original bevel.

3. To sharpen THE SPUR, hold the Bit in the left hand with the Twist resting on edge of bench. Turn the Bit around until the Spur you wish to sharpen comes uppermost. File side of Spur, next to Screw, keeping the original bevel. File lightly, until a burr is thrown upon the outside of the Spur. Remove this burr by a careful brush of the file; a fine cutting edge will be the result. Never use a file on the outside of the Spur except for the above purpose.

Great care should be taken to sharpen the opposite Lips and Spurs alike.

THE HAMMER AND MALLET.

Pupils are apt to use these tools interchangeably and they should be made to understand the use of each at once. The hammer should be carefully examined and the following points brought out. Shape and use of the claw. Reason for the rounded face. Reason for the shape of the handle. Great stress should be laid on the proper handling of the hammer as pupils nearly always hold it too near the head.

The foregoing paragraphs cover the points that it is desirable to emphasize, but the teacher should be familiar with the more extended treatment given in the books of reference. Special tools as the rabbet plane, etc., should be explained as used. It has been found that a very good method of impressing the points on the pupils is to give the instruction as outlined at first orally and at the next lesson dictate the portions marked "Note." This will teach the pupils the spelling of the names of the tools and the other words that are unusual. The sketches given should be made as far as possible from the object, but where the sketch is too difficult as in the case of the section of the plane the pupil should copy the teacher's sketch, which should be put on the blackboard. All the sketches given should be put on the blackboard by the teacher, and if note books are not kept the sketches should be left on the board as long as possible in order to familiarize the pupils with the spelling and form of the terms.

THE FILE AND FILING.

W. H. VAN DERVOORT.

A piece of high-grade crucible steel, forged to shape, ground, cut and carefully tempered, forms that tool so indispensable to the mechanic—the file.

The file maker is no longer compelled to forge his blanks from stock of unsuitable proportion, but receives from the steel manufacturers stock of the required cross-section to make all standard shapes. This reduces the forging to a minimum, it being only necessary to cut the stock to the required lengths, to draw down the point and form the tang, the latter operation being very rapidly performed under power hammers.

The National Association of File Manufacturers prescribe to the steel makers the forms of cross-sections they require. Consequently, all makers of file steel can furnish any sections correct to

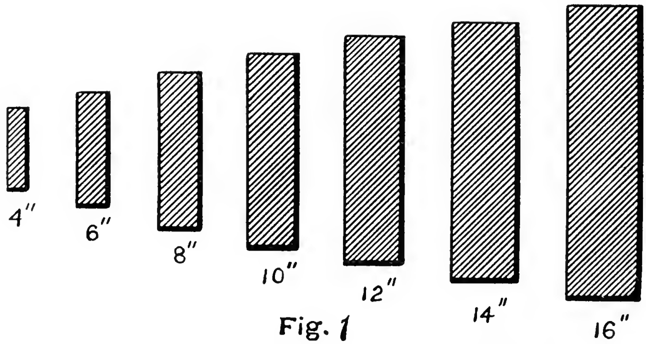


Fig. 1

gauge. In Fig. 1 are shown the correct cross-sections of steel for flat files, even inch lengths, from 4 to 16 inches. In Fig. 2 are shown the cross-sections of file steel for all the shapes in general use. Each section is for an 8″ file, full scale. The names of the files made from steel of these sections are, referring to the numbers of the figure: 1, "Hand"; 2, "Flat"; 3, "Mill"; 4, "Pillar"; 5, "Warding"; 6, "Square"; 7, "Round"; 8, "Half-round"; 9, "Three-square"; 10, "Knife"; 11, "Pit-saw"; 12, "Crossing"; 13, "Tumbler"; 14, "Cross-cut"; 15, "Feather-edge"; 16, "Cant-saw"; 17, "Cant-file"; 18, "Cabinet"; 19, "Shoe-rasp"; 20, "Rasp."

It will be noticed that many of these files are named from the form of their cross-section, and that those so named are the ones most used for general work; while the others receive their names from the special character of the work they are expected to be used upon. It will also be noted that the stock for files of rectangular cross section may be classified as to thickness as follows: "Mill," "Square," "Pillar," "Hand," "Flat," "Rasp" and "Warding." As to width, "Hand" is the widest; "Flat," "Rasp," "Mill" and "Warding" are the same width; "Pillar" materially narrower, and "Square" the narrowest.

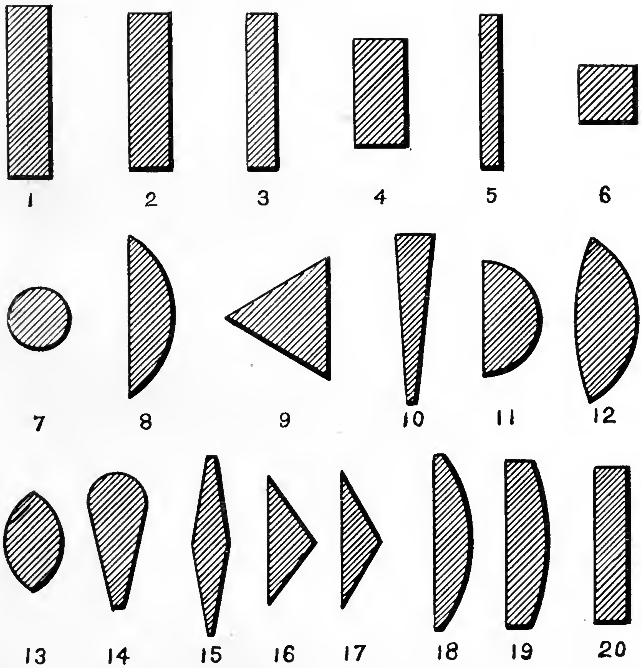


Fig. 2

The "Half-round" is not a full semi-circle, the arc being about one-third of the full circle. On the other hand, the "Pit-saw" is a full half circle in section.

The "Three-square," "Cant-saw" and "Cant-file" differ in section in their angles, the former having equal angles, 60° and equal sides, the next 35°, 35° and 110° angles, and the latter 30°, 30° and 120° angles.

The length of a file is measured from point to heel, and does not include the tang. The tang is usually made spike shaped to receive a plain ferrule handle. Some makers modify the form of tang to fit patented handles.

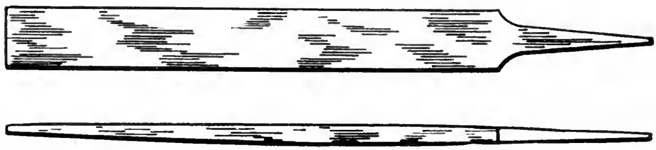


Fig. 3

As forged, the blank for a "Hand" file, Fig. 3, is parallel in thickness from heel to middle and tapered from middle to point, making the point about one-half the thickness of the stock. The edges of the blank are usually left parallel. They are, however, sometimes drawn in slightly at the point.

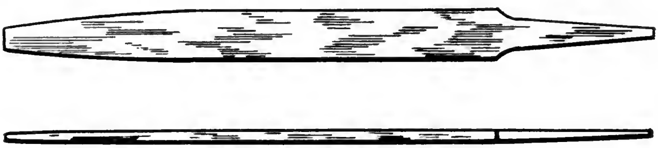


Fig. 4.

The "Flat" file blank, Fig. 4, is parallel in both of its longitudinal sections from heel to middle and tapered in both sections from middle to point, the thickness of point being about two-thirds and width about one-half that of the stock.

For the "Mill" file the blank is parallel in thickness from heel to point, and usually tapered to about three-fourths the width of the stock. The "Mill" file is often made blunt—that is, of equal width and thickness throughout its length.

The blank for the "Warding" file is tapered in width from heel to point and is of uniform thickness. Aside from width, the "Pillar" file is similar to the "Hand" file. The "Pillar" file is.

also made in "narrow" and extra narrow patterns, the extra narrow approximating a square in section.

The "Three-square," "Square" and "Round" are also made in slim and blunt forms. The "Slim" is a file of regular length, but smaller cross-section, and the "Blunt" of equal cross-section from heel to point, being either "slim" or regular.

After forging, the blanks are thoroughly annealed in annealing furnaces, the operation taking from twenty-four to thirty-six hours. When the blank comes from the furnace, it is twisted and scaly, and must be subjected to a "straightening" process, after which the scale is removed by "grinding" on very heavy grindstones. The blanks are next draw-filed to make them perfectly smooth and even, after which they are ready for the cutting.

Files are classified under three heads—"Single cut," "Double-cut" and "Rasp." The "Single-cut" file—or "Float," as its coarser cuts are sometimes called—has surfaces covered with teeth made by single rows of parallel chisel cuts extending across the faces at an angle of from 65° to 85° with the length of the file. The size of this angle depends on the form of the file and the nature of the work it is to perform.

The "Double-cut" file has two rows of chisel cuts crossing each other. The first row is, for general work, at an angle with the length of the file of from 40° to 45°, and the second row from 70° to 80°. In the "Double-cut" finishing files the angle of the first cut is about 30°, and the second from 80° to 87° with the axis of the file. The "Double-cut" gives a broken tooth, the surface of the file being made up of a large number of small, oval-pointed teeth inclined toward the point, and resembling in shape the cutting end of a diamond pointed cold chisel.

In the rasp the teeth are entirely disconnected from each other. They are round on top, and are formed by raising, with a punch, small portions of stock from the surface of the blank. The machinist seldom has use for a rasp, as they are intended for filing the softer materials, as wood and leather.

The regular grades of cut upon which the coarseness of a file depends are "Rough," "Coarse," "Bastard," "Second-cut," "Smooth" and "Dead-smooth." The "Rough" file is usually single cut and the "Dead-smooth" double cut. The other grades are made in both double and single cut. These grades of coarseness are, however, only comparable when files of the same length are considered, as the longer the file in any cut, the fewer

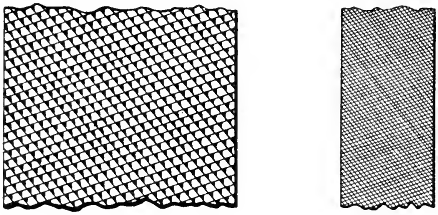
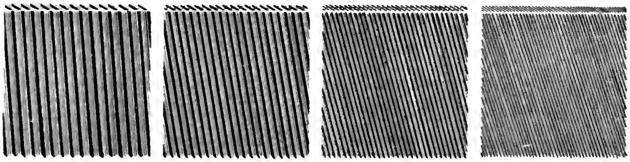


Fig. 5.

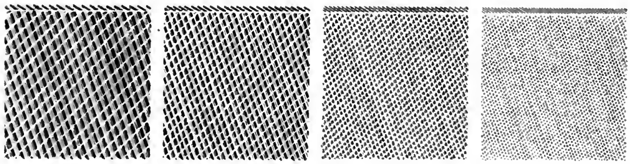
the teeth per inch of length. This is shown in Fig. 5, where a 4″ and 12″ "Bastard" file are placed side by side for comparison.

The relative degrees of coarseness for the different cuts are



COARSE. BASTARD. SECOND CUT. SMOOTH.

FIG. 6. SINGLE CUT.



COARSE. BASTARD. SECOND CUT. SMOOTH.

FIG. 7. DOUBLE CUT.

shown, for the "Single-cut" in Fig. 6, and the "Double-cut" in Fig. 7, a portion of an 8″ file being taken in each case.

The value of a file depends entirely upon three things—quality of stock from which it is made, the form of its teeth and the temper. The stock should be of the very best, as tool steel is seldom put to any use where its lasting qualities are more severely taxed.

As to the forming of the teeth: It is only within the past few years that machine-cut files have come prominently upon the market, it being generally believed that a file to be first-class must be hand cut. The difference between these cuts is so slight that only an expert, with the files, could tell, with any degree of certainty, which was hand and which machine cut.

Up to the time of the perfecting of the increment cut file, the great trouble with machine-cut files was in the perfect uniformity of the teeth. In a hand-cut file the width and spacing of the teeth depend entirely upon the skill of the workman; and no matter how carefully he does the cutting, irregularities of a thousandth of an inch, more or less, will occur in the spacing and in the angle at which he holds the broad chisel that forms the teeth. These slight variations will cause the teeth to be of uneven height and irregular outline. These irregularities are now very faithfully reproduced in the increment, machine-cut file.

It is difficult to make a file having teeth of uniform height and outline, as in the case of the ordinary machine-cut file, take hold of the work. The reason for this is that so many teeth present themselves to the work surface that the workman must exert great pressure on the file to make them bite. With the file having teeth of irregular height, fewer will come in contact with the work, and the pressure required to make them take hold will be correspondingly light. As these long teeth wear down, the shorter ones will begin to do work; but the file will, of course, not cut so freely as when new. Again, in using the file with teeth of uniform height, it will, when pushed to the work, produce, at the start, grooves which will grow deeper as the file is moved forward, and, due to the broad cut, will be quite certain to vibrate and "chatter." On the other hand, the uneven teeth of the hand and increment cut files will so adapt themselves to the surface of the work that only a few teeth at any particular point in the length of the file will cut. The metal left between these teeth will be removed by the teeth following, perhaps a dozen or more rows of teeth being required to finish the cut started by one. This is shown, for a "Single-cut" file, in Fig. 9, where the several irregular lines represent as many tooth outlines drawn on an exaggerated scale. These teeth come successively to the work, and if all their high points were brought together they would form a straight line, as shown, which would be the outline of the resulting cut.

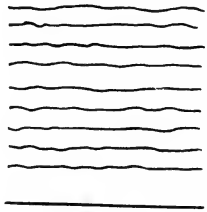


Fig. 9.

The cutting of an increment cut file consists in the forming of the teeth by a chisel operated in a machine, and so controlled that the spacing between teeth may be increased or decreased, the same being subject to a small amount of irregularity, as well as a slight variation in the angle of the teeth with each other. As manufactured by one company, the spacing of the teeth from point to middle is increased, and from middle to heel decreased. Another leading manufacturer increases the pitch from point to heel. It will be understood that the increment of space is very small. In a 12″ "Bastard" file, having teeth spaced progressively wider from point to heel, the pitch of teeth at heel is about .01 of an inch greater than at the point, which makes the average increase per tooth about .000030 of an inch.

In machine-made files the cutting is very rapidly performed, the chisel receiving from 500 to 3,500 blows per minute, depending on the weight of the file being cut. The blank is cut from point to heel, and when turned over is placed on lead strips to protect the teeth already formed.

After cutting, the files are inspected and assorted as to quality. They are then tempered, any material change in shape due to hardening being rectified at the time of tempering, after which they are ready for final inspection. This consists of trying each file on a piece of hard steel and making sure that it is free from temper cracks. They are next coated with oil and wrapped in oiled paper, to prevent rusting, after which they are packed in boxes, ready for the market.

The teeth of a file remove metal by a shearing cut. This is most apparent in the "Single-cut" files, where the teeth have lateral length; but is equally true of the pointed tooth of the "Double-cut" file.

A file bites freer on work having a narrow surface than a wide, because fewer teeth come in contact, at any point in the stroke, with the work surface, and consequently less pressure is required to make the file bite. On very thin work the teeth of a "Double-cut" file bite so freely that the danger of breaking them is great. For work of this character the long tooth of the "Single-cut" is best adapted, as its form gives it greater strength, and the shear of the cut is smoother, one tooth coming into cut as another leaves. On the broad surfaces, however, the teeth of the "Double-cut" have the advantage.

A file is "tapered" when it is thinner at the point than at the middle, and is "full tapered" when thinner at point and heel than at the middle. The reasons for thus tapering a file are, first, to reduce the number of teeth that come in contact with the work, and, second, to enable the operator to file a straight or plane sur-

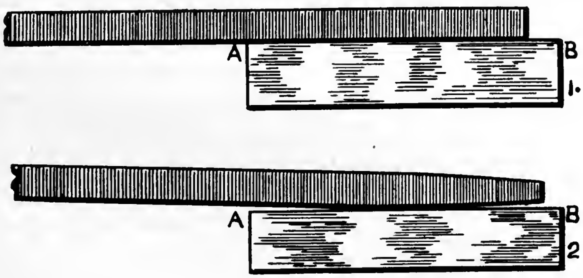


Fig. 10.

face. The first reason is evident; the second is shown in Fig. 10. If the file is perfectly straight, as shown in 1, the motion in order to produce a plane surface on the work must be absolutely parallel to this surface. This the most expert mechanic can scarcely be expected to do, and the result will be work rounded at the edges *A* and *B*. If the file is tapered, its surface will be slightly convex, as shown in 2, and if moved entirely across the surface, straight work will result. The workman will experience little difficulty in accomplishing this, as he can allow the motion of the file to deviate slightly from a straight line, and still not cut away the edges *A* and *B*. If the file is not moved clear across the work, a concave surface will of course result.

The tempering is certain to distort the file somewhat, and it will, as a result, usually be found to have more "belly," as this convex is usually called, on one side than on the other. It is the side having the most "belly," and the highest part of that, that the careful mechanic will always select for use in his most particular work. This high point he readily finds by running his eye along the edge from point to heel.

In filing the non-fibrous metals, as cast iron and brass, sharper files are required than for work on steel and wrought iron. Broad surfaces require, as indicated above, sharper files than narrow ones. The systematic workman will therefore use his new files on broad surfaces of cast iron and brass, next on the narrow and when dulled to such an extent as not to readily take hold of these metals, he will use them for work on wrought iron and steel, and finally, when too dull for efficient work, may be used for smoothing up and removing the hard scale from castings and forgings.

A new or good file should never be used on rough castings, as the scale of cast iron is often very hard, and will ruin the file after a few strokes. The edge of the file can be used to advantage for this work, as it is seldom used for other purposes.

When the file is pushed endwise across the work, it is called cross filing. The work is performed on the forward stroke and the file released from all cutting duty on the return stroke. It should not, however, on the return stroke be raised from the work, except at such times as may be necessary to examine the condition of the surface. As the file is pushed forward, it should be given a slight side motion, and after a number of strokes the direction should be changed, so as to make the file marks cross at quite an angle. This will increase the cutting of the file, and will keep the work true by preventing deep grooving.

The handle of the file in cross filing should be held in the right hand, preferably with the end of the handle seated against the palm and the thumb extended along the top. The point is held under the ball of the left thumb, the fingers pressing upward against the lower side. In using thin files the downward pressure at heel and point may spring them until they are concave instead of convex to the work surface. In this case the point must be so held between thumb and fingers that the fingers exert an upward pressure under the point and the thumb a downward pressure a few inches back from the point, which will tend to make the file more convex to the work surface. It is a tiresome way to hold the tool, but will at times be found necessary.

In filing broad surfaces the work should be placed low, thus enabling the operator to reach all points of its surface and to put the required pressure on the file. For work held in the vise or on the bench, the surface being filed should be at about the height of the workman's elbow, so as to give the forearm holding the file handle a nearly horizontal motion. If the work is fine and delicate, it is preferable to hold it higher, as it can then be more readily inspected.

In draw filing the motion of the file is at right angles to its length. It is firmly held in both hands at heel and point, the handle usually being removed. In draw filing the metal is removed much slower than in cross filing, with the same cut of file; but the surface left is smoother, is not so apt to be scratched in the operation, and will take a better finish. Draw filing requires less skill than cross filing, the beginner being able to produce very creditable work after comparatively little practice. Cross filing, on the other hand, requires skill and experience when smooth, plane surfaces are to be made.

The character of the work and the surface required will determine the coarseness of the file the mechanic will select for performing it. The "bastard," "second-cut" and "smooth" are the cuts most used by the machinist on general work. The "rough" and "coarse" cuts are used mostly on the softer metals where a large amount of stock is to be removed quickly. The fine-cut files will take hold of the harder metals better than the coarser files, and will leave the surface smoother.

The file must be kept free from the cuttings which lodge between the teeth. When lodged too firmly to be removed by tapping the edge of the file against the vise back, they should be scraped out with a soft wire file card or brush. When working on wrought iron or steel, cuttings will lodge so firmly that they cannot be brushed out, but must be picked out with soft iron scorer. They will often project above the teeth and cause deep scratches in the work. This annoying trouble is called "pinning." It may be lessened somewhat by thoroughly chalking the surface of the file, which also prevents its cutting so freely.

When filing work in a lathe, care must be taken not to run the surface filed too fast. It must be remembered that, ordinarily, the motion of the file to the work is comparatively slow—say, forty strokes per minute, of perhaps 8 inches each. As the file is cutting only about one-half the time, the actual velocity of cut in this case would be not far from 50 feet per minute. The intermittent motion of the cut prevents the teeth becoming extremely hot. In filing revolving work, the number of strokes per minute will not be so great, but the length of stroke will be somewhat increased; so the actual cutting speed due to the motion of the file will not be much less than in cross filing. To this must be added the speed of the work, which will vary from 50 to 100 feet per minute. It will be understood that, in filing stationary work a comparatively short length of the file's surface is cutting, whereas in filing rotating work, nearly all of the file's length is brought into use at each stroke, which offsets largely the disastrous effects on the teeth due to too high a cutting velocity. The file must not

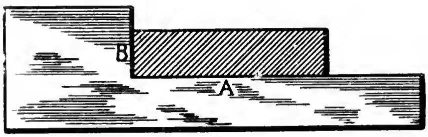


Fig. 11.

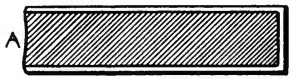


Fig. 12.

be held stationary, allowing the work to revolve to it, as in that case a few teeth do all the cutting and leave a grooved surface. As the file is moved forward, it should, as in cross filing, be given a small amount of lateral motion, first to the right and then to the left, causing the file marks to cross at quite an abrupt angle. Rotating work should be filed as little as possible, in order to obtain the desired finish, it being almost impossible to retain the cylindrical truth of the work if filed too much.

A safety edge on a file is one having no teeth. The safety edge enables the mechanic to file one of two surfaces *A*, intersecting at right angles, without injuring the other *B*, as shown in Fig. 11. The safety edge on a new file should always be passed over a grindstone or emery wheel before depending on its "safety," as in the cutting of the sides the stock is expanded over the edge, making a slight concave, as shown at *A*, in Fig. 12. While the points of the teeth do not, in cutting, form out full over the safety edge, the roots of the teeth do, and they are very apt to scratch the surface the edge is expected to protect. A very satisfactory safety edge is made by grinding the teeth from the edge of a full cut file.

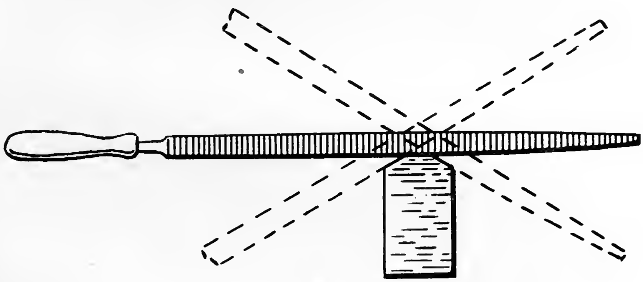


Fig. 13.

When a large amount of metal is to be removed quickly, the file may be used at different angles, as shown in Fig. 13. This decreases the area of cut and increases the bite of the file. A new file should never be used for this purpose, as the keen edge of the teeth would be broken off. All work surfaces, especially if narrow, should be held as near the top of the vise jaws as possible, thus preventing vibration.

Good workmen will keep the files they are using in a rack or drawer, so arranged that they cannot come in contact with each other. When we consider the amount of metal a file will remove under favorable conditions, we are impressed with the expense of the tool when improperly used. Far too many are ruined through carelessness.

THE TOOL HOUSE AT HOME.

The following article we copy from the July, 1895, "Century." It is by Bayard T. Putnam:

"I wish to present a plea for a 'tool house' at home for the young people, and one well stocked with the best tools. A great deal of creditable work has doubtless been done with a jack-knife and an old cross-cut saw, reinforced, possibly, with a half-worn-out smoothing plane, a rusty bit or two, and, perhaps, a chisel; and a certain amount of ingenuity has unquestionably been developed by the adaptation of these tools to the work in hand. But, after all, the best that can usually be said of such work is that it is very well done considering the means. The edges are rarely square and true, the joints are rarely well made, and the time consumed on the "job" is apt to be unduly prolonged, so that the work, if intended for something more than a mere makeshift, becomes wearisome before it is completed. A necessary consequence is that the boy (or girl, for there is no reason why a girl should be ignorant of the use of tools) becomes discouraged with his work, and decides that his forte is in some other direction. If on the other hand, a boy once becomes familiar with the use of good tools—tools such as an artisan would use for the same work—the knowledge stands by him, and is a source of constant pleasure and often of some profit. In a few words, to use a Western expression, the best tools ought not to be 'too rich for the blood' of any intelligent American boy."

WORDS OF WISDOM.

We feel justified in the above title because the following was not written by ourselves but "cribbed" from some one greater. With the exception of the first paragraph the article is anonymous.

"One year's faithful practice at a mechanical employment before the age of ten, will make a youth more efficient in future than two years after that time."—*Spencer*.

*   *   *   *   *   *   *   *   *

"The above is good advice: If acted upon with boys, it would produce strong minds, and strong healthy bodies. Would you cultivate the understanding of your boy, cultivate the powers it is to govern; exercise his mind and body at the same time in a useful manner—for the grand secret of education is to contrive that the exercise of the body and that of the mind may always serve as relaxation to each other. If one-tenth of the time which is employed in practising gymnastic exercises were directed to the acquisition of adequate industrial habits, the physical faculties of pupils would be as well developed and their power incomparably increased. Skill in the use of tools is of incalculable advantage. It gives useful employment to many an otherwise idle hour. It prompts one to add a thousand little conveniences to the house, which, but for this skill would never be made. In a word, it is carrying out, in a fuller sense, the design of the Creator, when he implanted the faculty of constructiveness within us. A bent for mechanical pursuits usually manifests itself at a very early period in life; the inclination of the six-year-old boy to hammer and pound, to tear open toys and clocks to 'see what makes 'em go,' all so annoying to the careful parent, may be taken as indications of latent constructive genius, although now manifested in a very destructive form. In the youth the mechanical bias becomes still more apparent, manifesting itself in attempts to construct wagons, boats, small engines, etc. With such a boy a mechanical education is no doubtful experiment."

*   *   *   *   *   *   *   *   *

Give your boys a box of *good tools*, and if possible a room or place for a workshop. Employed in it, they will not only be kept out of mischief, but they will be strengthening their muscles, exercising their mental powers, and fitting themselves for greater usefulness, when they shall be called upon to take their places in the ranks of men.

A POT OF GLUE.

Many men use glue all their lives and know but little of where it is made, or how. We will tell what we can, and that is not much after all—for it is an old saying, among both manufacturers and merchants, that the more you have to do with glue, the less you think you know about it.

There are three leading kinds: First, Hide Glue, which is made of the hides or sinews of cattle and such beasts. The pieces of hide cut off by the butcher and tanner, which are of no use in making leather, are soaked in lime water a longer or shorter time, according to their condition. The lime eats away the fatty or partly decayed matter, leaving the glue substance uninjured, provided the process is not continued too long. This stock is then carefully washed and put into large kettles, where the glue liquor is readily boiled out and the insoluble fibre sinks to the bottom. The glue liquor is poured into pans, where it cools and hardens and is just such a substance as calves'-foot jelly when served on the table. When cold, the jelly is turned out of the pans and sliced, and the sheets laid on nets and dried.

The second kind—Bone Glue—is made of the largest bones of cattle, and only differs from the other method in softening the stock by an acid, instead of a lime solution.

Sixty per cent. of bone is lime, the other forty per cent. (or thereabouts) is glue.

The third kind of glue is made from the feet of cattle and hogs; their hoofs contain a large proportion of glue matter, and this is simply washed and then boiled out.

As to which is best of the kinds mentioned, it is hard to decide between the first and second, the hide stock and the acid-treated bone stock glues. The greater purity and beauty belong most surely to the bone stock glue, and for work requiring delicacy as well as strength, it is unequalled. But the acid left in it, and which it is hard to wholly eradicate, qualifies its use for many purposes. In stiffening straw goods and finishing silks, and for very fine-grained and hard-surfaced wood work, it is admirable.

But, if we had no bone glue at all, we could get along very well. What would we do, however, if we had no glue made of hide stock? Thick flowing or thin flowing, dark color or light, slow settling or quick, rigid or elastic, it embraces them all. It is an old saying "that glue is the poor workman's best friend"—that means hide stock glue, which is the cheapest because it is the best.

A great improvement was made twenty years ago, when a means of grinding glue and at nominal cost was devised. Ground glue is now extensively used. It is indeed not the poor workman's but the good workman's best friend.

Now, a word as to the way to use glue. To begin with, glue is animal matter. A ham will keep a long time uncooked, but who would soak it over night and forget it the next day and expect to find the ham sweet; or who would soak and cook it in a pot where other hams have been cooked and the pot never cleaned? Such treatment of glue is unworkmanlike and wasteful.

Then the glue maker knows when his glue is cooked enough, and that to cook it longer will hurt both its strength and color; yet many users think that they can cook glue for hours and get as good, or even better results. They really ought to soak and cook ahead just what they require. and use it as fresh as possible. If the glue is ground (as it should be) they can soak it in three minutes, or dissolve more in the melted glue that is in the pot in one minute, and always have their melted glue at its best.

We now come to a source of much trouble. Glue will not hold unless the pieces to be glued are put together while the glue is still hot and liquid. Its function is to sink into the fibres and grasp them, which it cannot do when chilled. In the Autumn, when cooler weather makes glue dry more quickly, we have complaints that the glue will not hold. A suggestion to the above effect is usually sufficient. Again take two woods: oak, which is close-grained, and pine, which is porous. One requires a thin-bodied and penetrating glue, to soak in and lay hold; the other needs a heavy-bodied glue, used thick; or the spongy wood will soak up the glue and leave nothing at all to hold with.

CHEAP GLUES ARE NOT ECONOMICAL.

The quality of glue is determined by the amount of water it will take, and glue is usually tested in this manner. Some of the cheap common, glues will not take the equivalent of their own weight in water.

The cheapest glue (No. 5) will take 4 oz. of water to one. The No. 10, from 5 to 6 oz. of water to one, and the No. 15 from 8 to 10 oz. of water to one of glue.

The above extreme proportions would be modified by practice, as different kinds of work require the glue to be thinner or thicker, as the case may be.

It will, then, be readily understood that a pound of glue, costing 10 cents, and which will only make a quart of the prepared article, is more expensive than a glue, costing twice the amount, that will make two and one-half quarts, this leaving out consideration of the fact, that quantity for quantity, the higher-priced glue is much stronger and more durable, and in fact, more desirable in every way.

GROUND GLUE.

In past years there has been among many users a prejudice, against ground glue; and there is some foundation for this prejudice, as there are unscrupulous manufacturers who grind inferior glues as a means of hiding their defects. It is not easy to tell much about glue when ground, but it possesses several advantages over the sheet glue. It requires but a few minutes soaking to dissolve, and for those who use glue occasionally, it is an easy matter to prepare just the amount needed and no more.

LIQUID GLUE.

Fish Glues are applicable to all purposes for which glue is employed, and are amongst the strongest adhesives known.

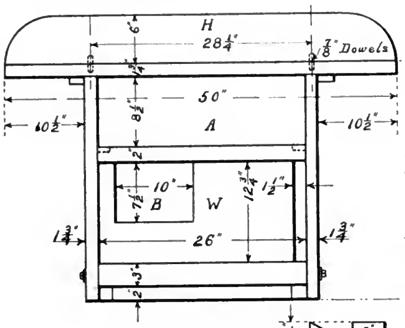
The advantages of liquid glues are found in the saving of labor, time and fuel necessary for preparing ordinary glues. To secure the best results, it should be applied with a short, stiff brush and rubbed off to a very thin coat.

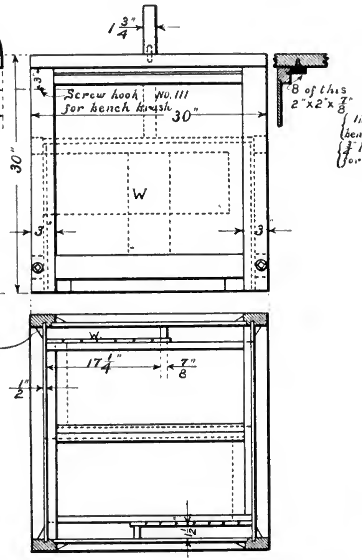
DESIGNS FOR EQUIPMENT OF A MANUAL TRAINING SHOP.

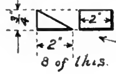
Upon the following pages (241 to 271) are shown designs for apparatus which has been designed for use in the Chicago Elementary Schools.

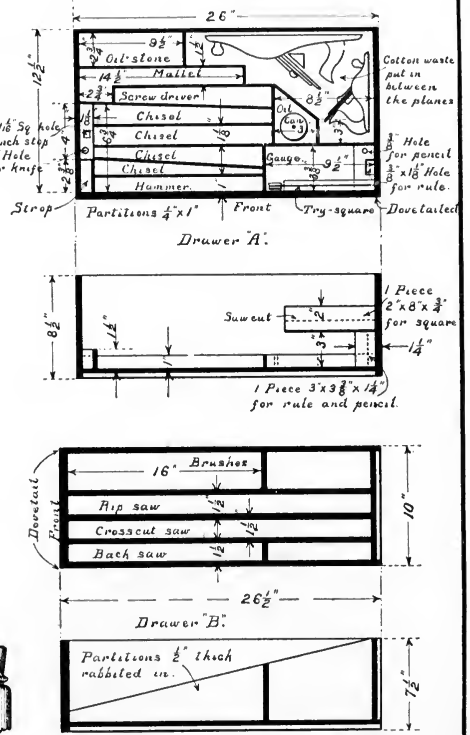
TWO PUPIL BENCH.

DOUBLE MANUAL TRAINING BENCH.



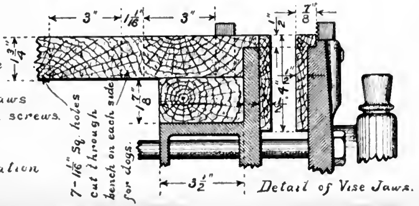






SPECIFICATIONS.

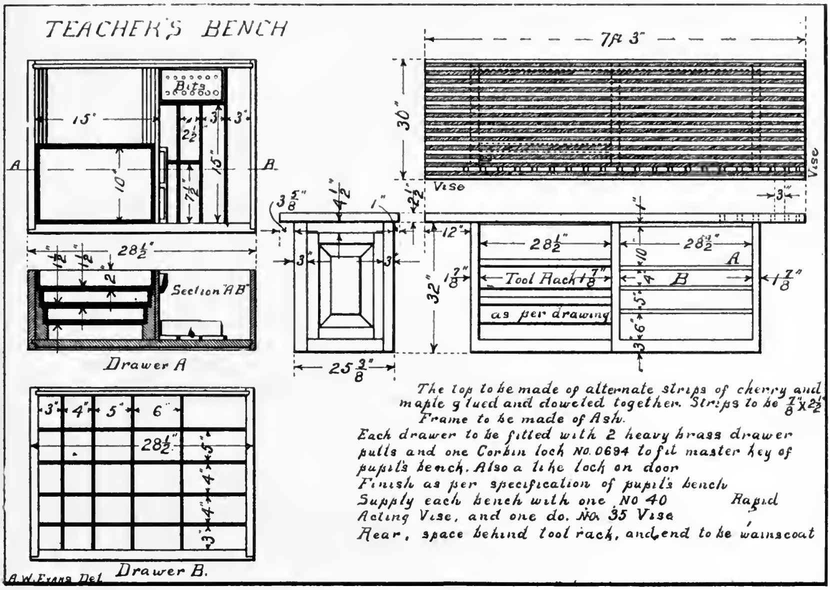
All lumber to be thoroughly seasoned.
Top to be made of (6) six pieces of birch, glued and doweled
Partition "H" to be made of birch.
Parts marked "W" to be ash wainscoat
Body to be made of ash
Finish with (2) two coats white shellac. (Pure grain alcohol.)
Provide all drawers with Corbin No 0634 locks.
Locks on "A" and "B" alike on one side of bench, to open with one key.
All pairs different, and a master key for all benches ordered
Drawer "A" to have (2) two and drawer "B" to have (1) one bronzed flush drawer pull.
All vises will be fitted with hard maple jaws rabbited and screwed to iron jaws with wood screws.
The iron jaws will be dropped down $\frac{1}{2}$" below bench top as shown
Vises will be furnished by the Board of Education

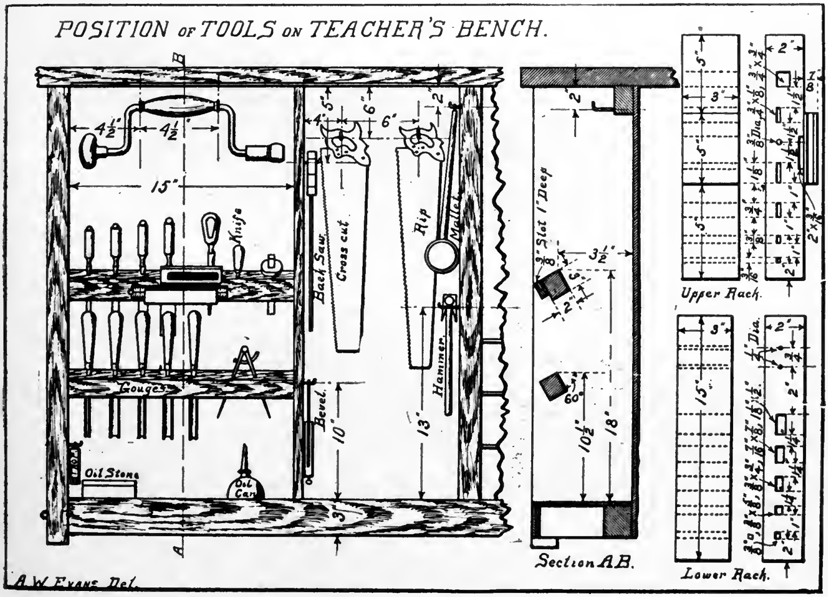


Detail of Vise Jaws.

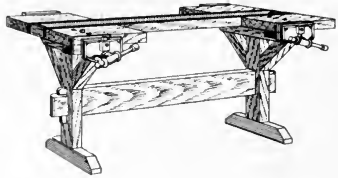
A. W. Evans Del.

R. F. Beardsley Designer.

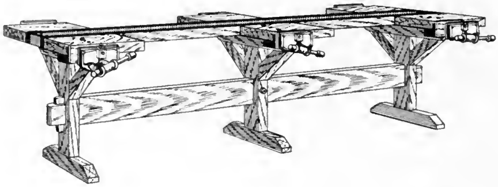

TEACHER'S BENCH
7 ft. 3"
Bits
Vise
Tool Rack
as per drawing
Section "AB"
Drawer A
Drawer B.
The top to be made of alternate strips of cherry and maple glued and doweled together. Strips to be 7/8" x 2 1/2".
Frame to be made of Ash.
Each drawer to be fitted with 2 heavy brass drawer pulls and one Corbin lock No. 0694 to fit master key of pupil's bench. Also a like lock on door
Finish as per specification of pupil's bench
Supply each bench with one No 40 Rapid Acting Vise, and one do. No. 35 Vise
Rear, space behind tool rack, and end to be wainscoat
A. W. Evans Del.


POSITION OF TOOLS ON TEACHER'S BENCH.
Knife
Gouges
Oil Stone
Oil Can
Back Saw
Cross cut
Rip
Mallet
Hammer
Bevel
3/8" Slot 1" Deep
Section AB.
Upper Rack.
Lower Rack.
A. W. Evans Del.

FOUR-PUPIL PRIMARY BENCH.

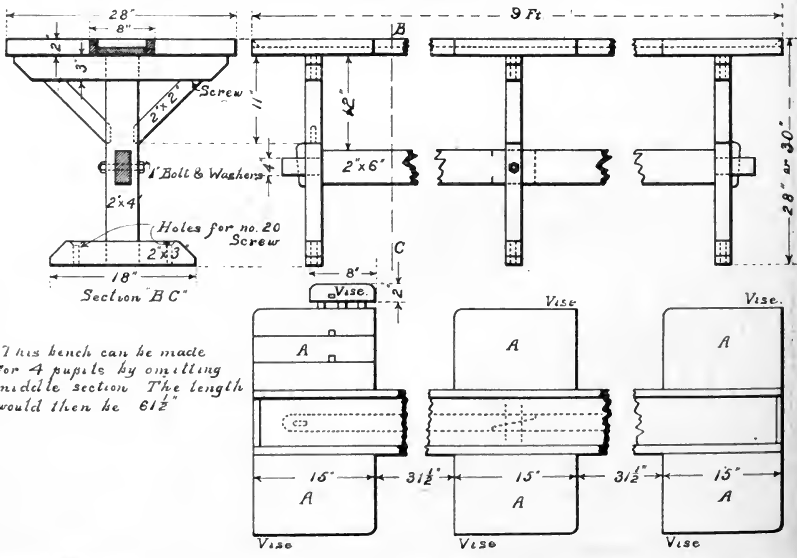


SIX-PUPIL PRIMARY BENCH.



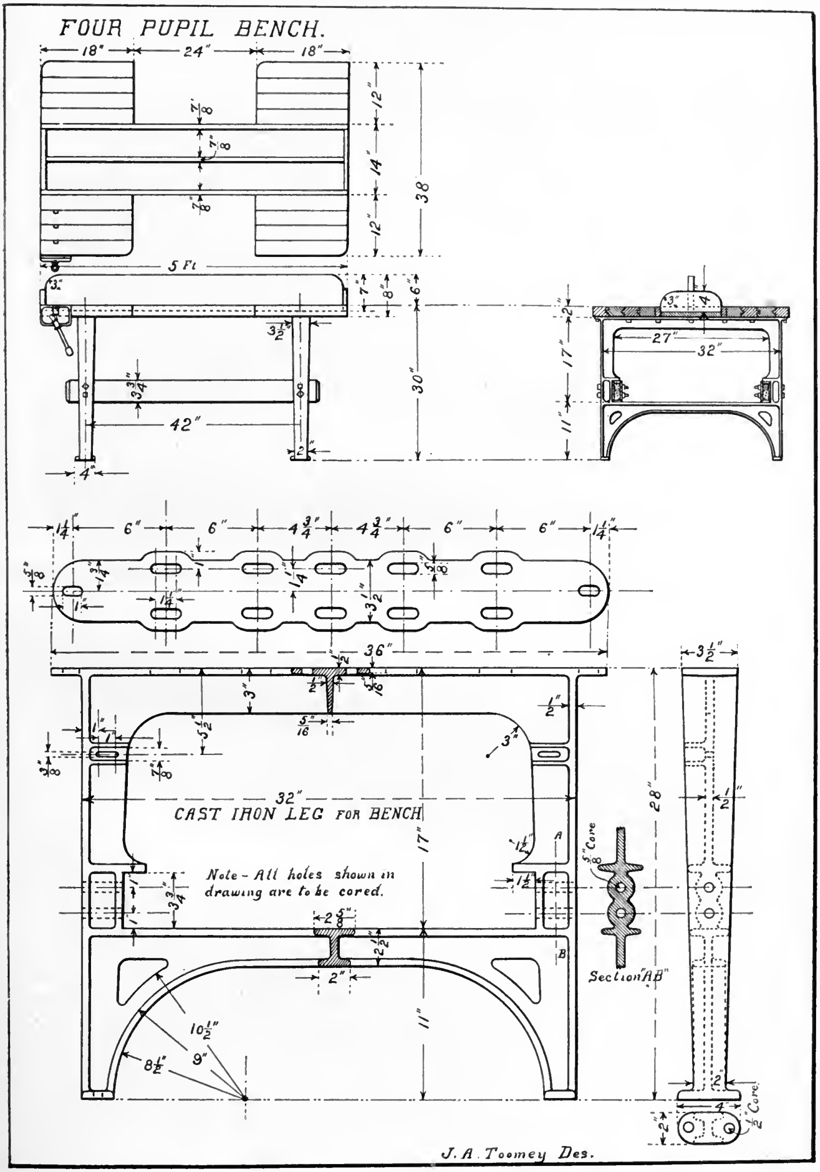
A W Evans Del.

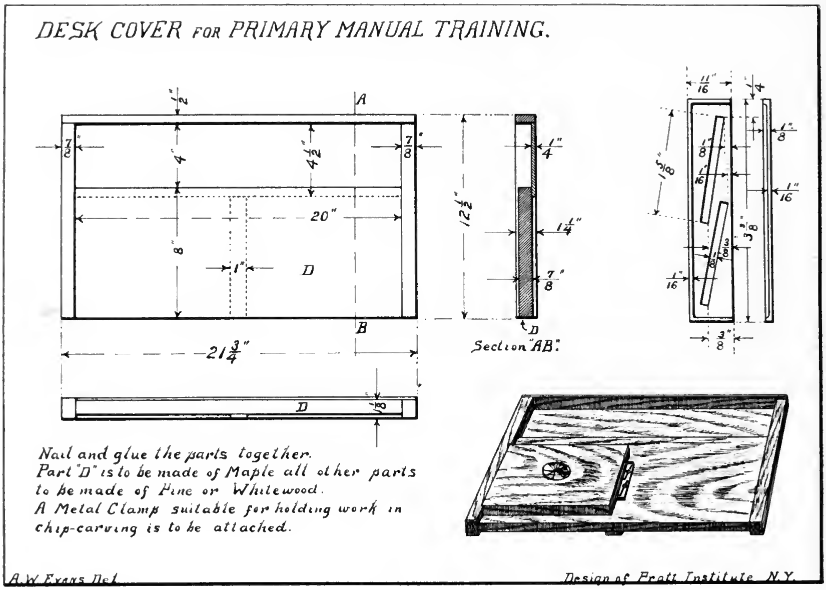
PRIMARY MANUAL TRAINING BENCH

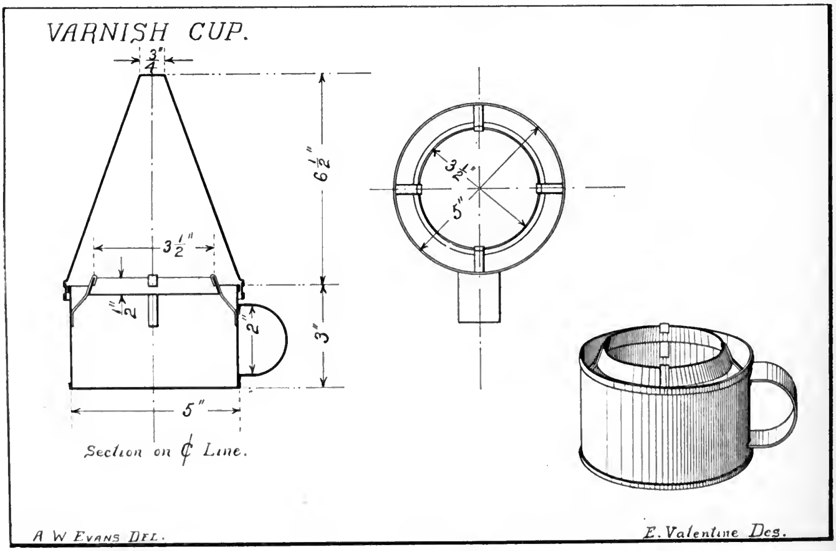


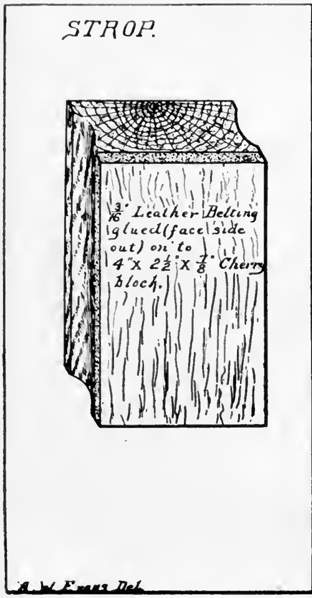
This bench can be made for 4 pupils by omitting middle section. The length would then be 61½"

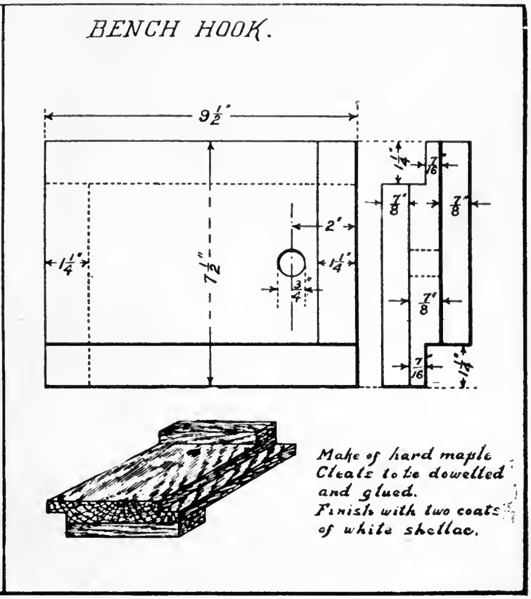
A. W. Evans Del.

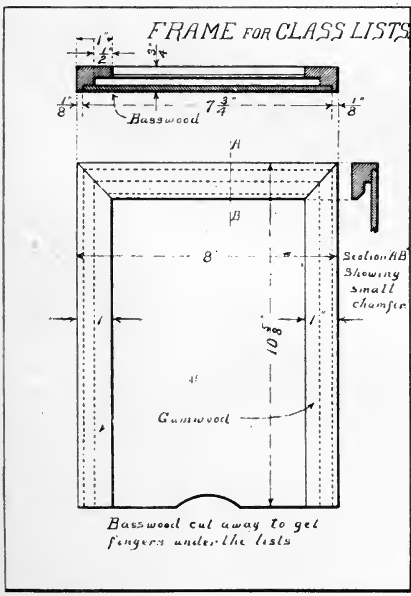

FOUR PUPIL BENCH.
CAST IRON LEG FOR BENCH
Note - All holes shown in drawing are to be cored.
Section "AB"
J. A. Toomey Des.

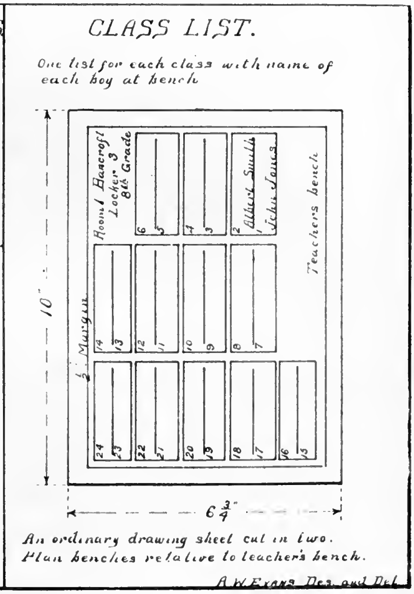

DESK COVER FOR PRIMARY MANUAL TRAINING.
Nail and glue the parts together.
Part "D" is to be made of Maple all other parts to be made of Pine or Whitewood.
A Metal Clamp suitable for holding work in chip-carving is to be attached.
Section "AB".
21 3/4"
20"
12 1/2"
A.W. Evans Del.
Design of Pratt Institute N.Y.

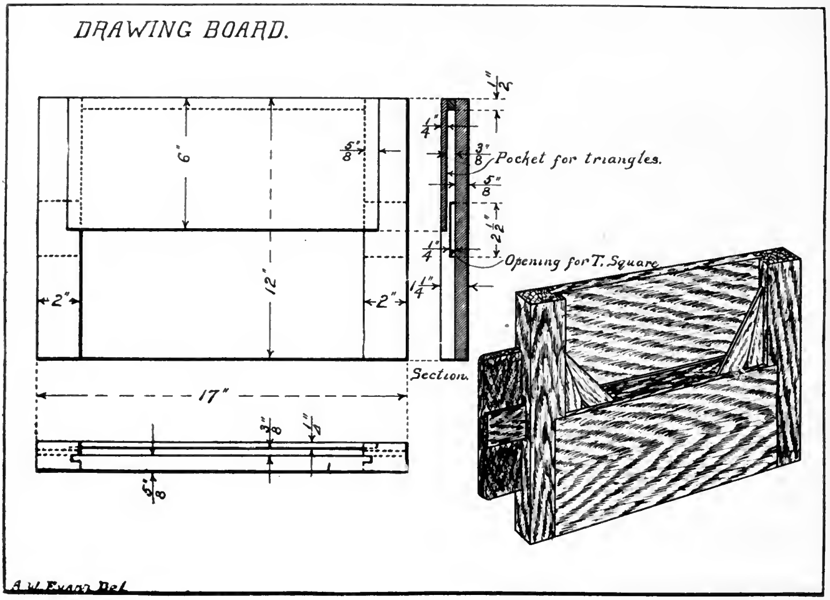

VARNISH CUP.
3/4"
6 1/2"
3 1/2"
3"
2"
5"
Section on ℄ Line.
A W Evans Del.
E. Valentine Des.

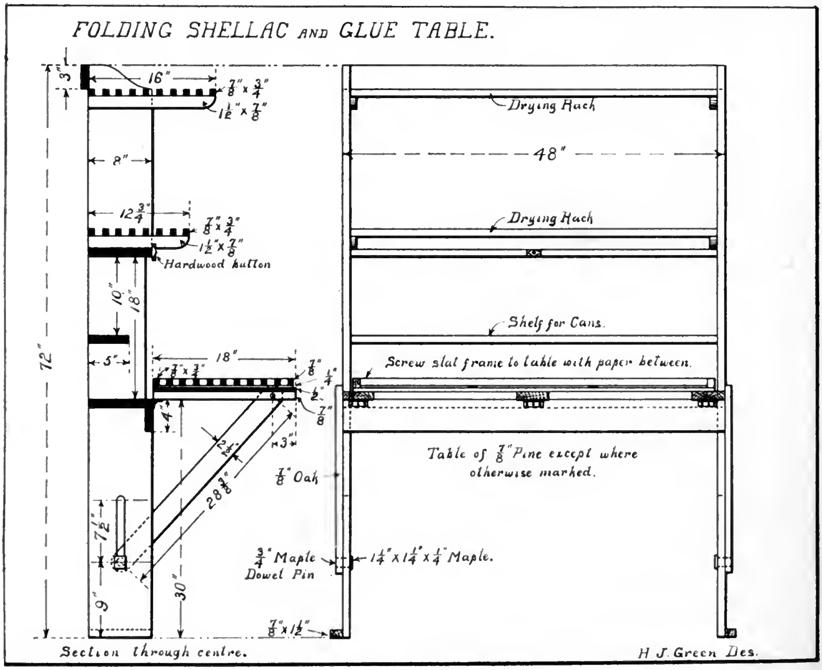

STROP.
3/16" Leather Belting glued (face side out) on to 4" x 2 1/2" x 7/8" Cherry block.
A. W. Evans Del.

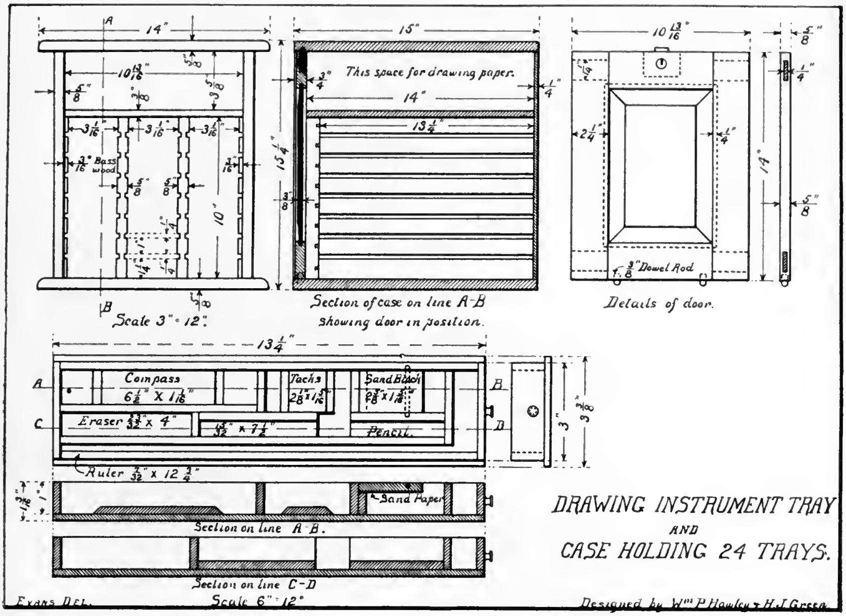

BENCH HOOK.
9 1/2"
7 1/2"
2"
1 1/4"
3/4"
7/8"
7/16"
Make of hard maple
Cleats to be dowelled and glued.
Finish with two coats of white shellac.


FRAME FOR CLASS LISTS
Basswood
7 3/4"
8"
10 5/8"
Section AB Showing small chamfer
Gumwood
Basswood cut away to get fingers under the lists


CLASS LIST.
One list for each class with name of each boy at bench
Room 1 Bancroft Locker 3 8th Grade
Albert Smith
John Jones
Teachers bench
Margin
10"
6 3/4"
An ordinary drawing sheet cut in two.
Plan benches relative to teacher's bench.
A. W. Evans Des. and Del.


DRAWING BOARD.
Pocket for triangles.
Opening for T. Square
Section.
17"
12"
6"
2"
A. W. Evans Del.


FOLDING SHELLAC AND GLUE TABLE.
Drying Rack
48"
Drying Rack
Shelf for Cans.
Screw slat frame to table with paper between.
Hardwood button
Table of 7/8" Pine except where otherwise marked.
7/8" Oak
3/4" Maple Dowel Pin
1 1/4" x 1 1/4" x 1/4" Maple.
72"
30"
Section through centre.
H. J. Green Des.



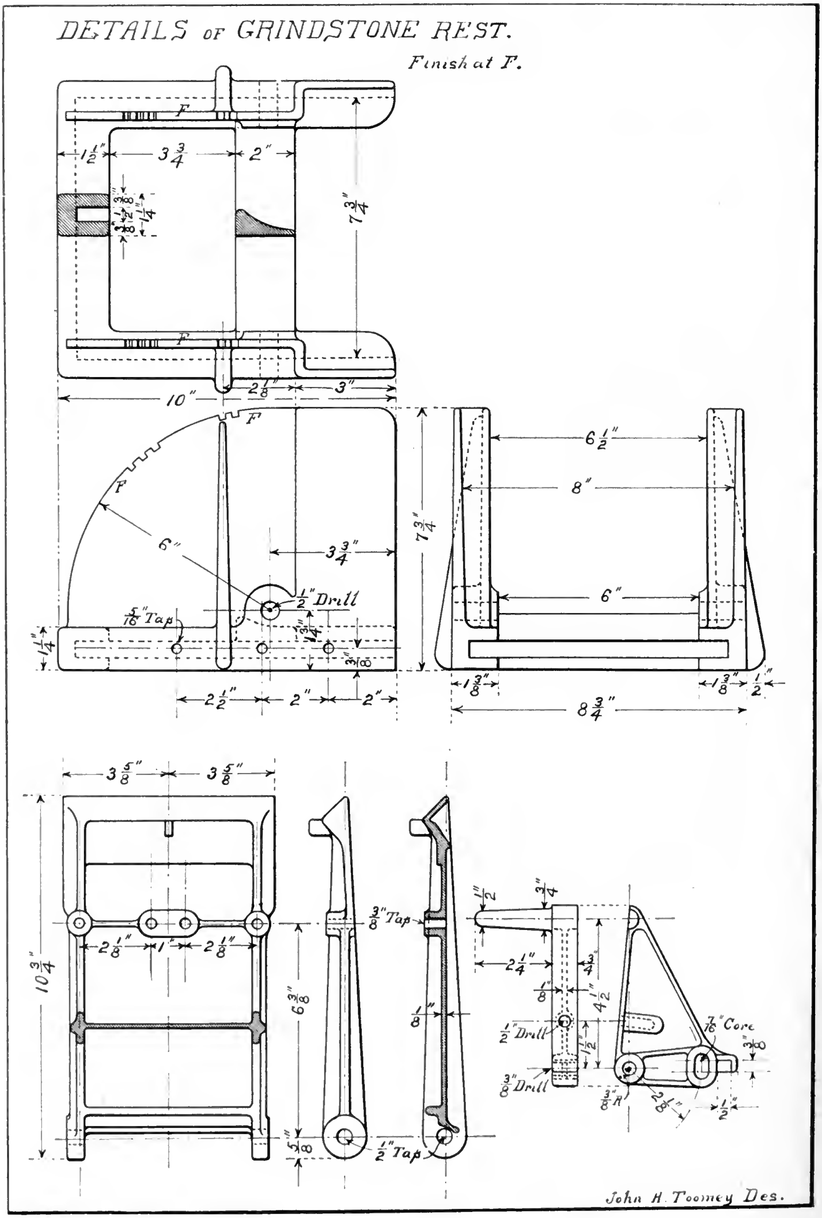
Case made of Whitewood, except $\frac{3}{16}''$ strips at sides, marked Basswood.

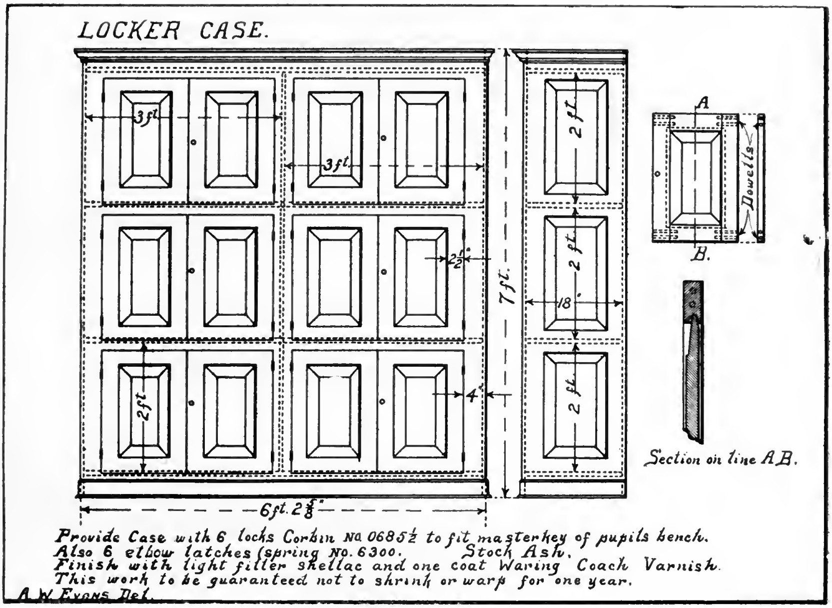
Bottom of Till made of $\frac{3}{16}''$ Basswood.

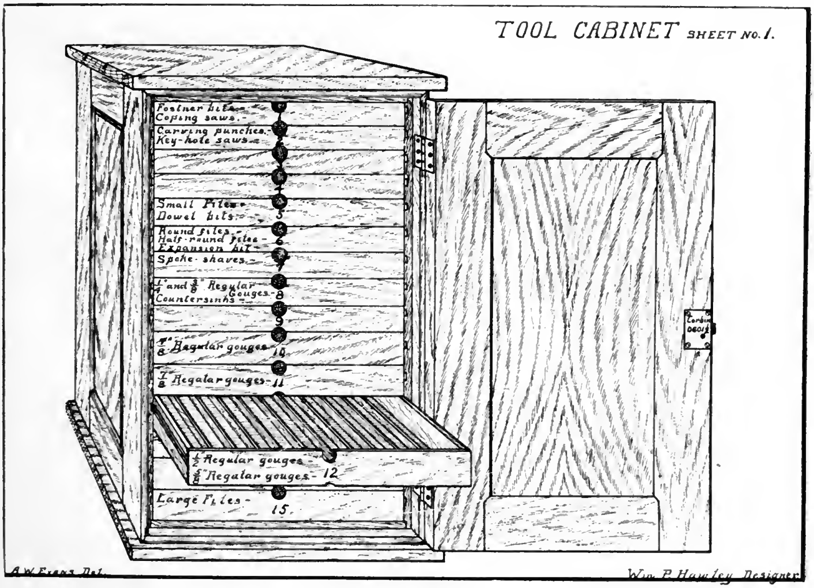
Divisions and sides of $\frac{1}{4}''$ x $1''$ Whitewood.

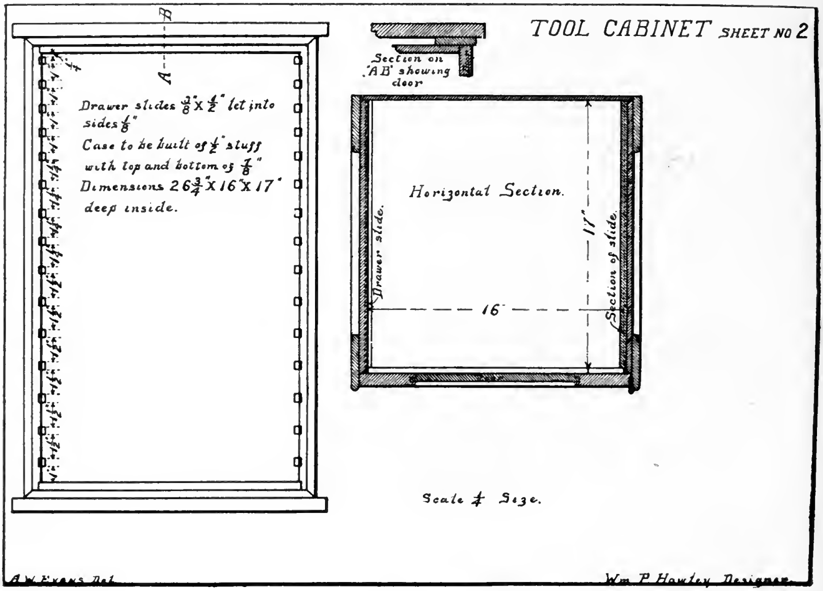
Cut pieces as follows and nail and glue together as per drawing.

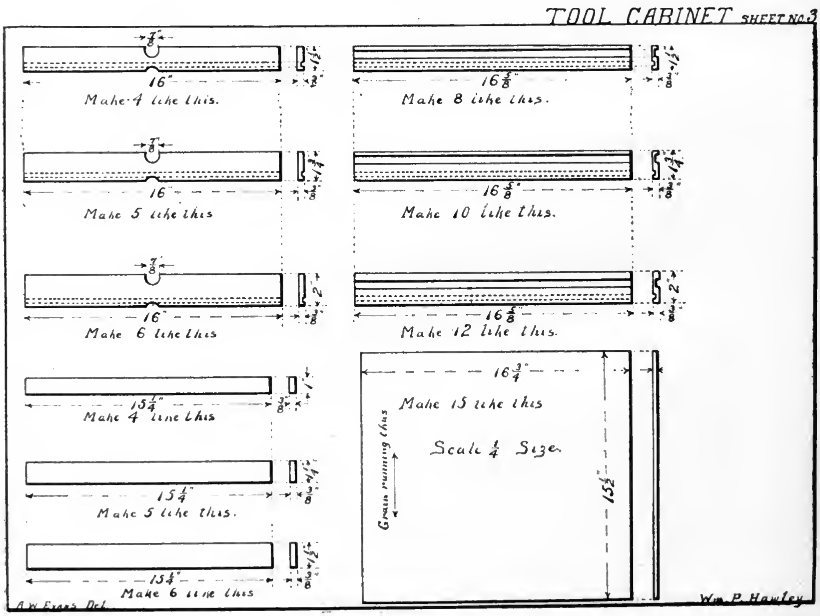
2 pieces $12\frac{3}{4}''$ long.	1 piece $11\frac{3}{4}''$ long.
2 " $1\frac{5}{16}''$ "	1 " $6''$ "
2 " $3''$ "	1 " $3\frac{5}{8}''$ "
	1 " $2\frac{7}{8}''$ "
	1 " $\frac{23}{32}''$ "

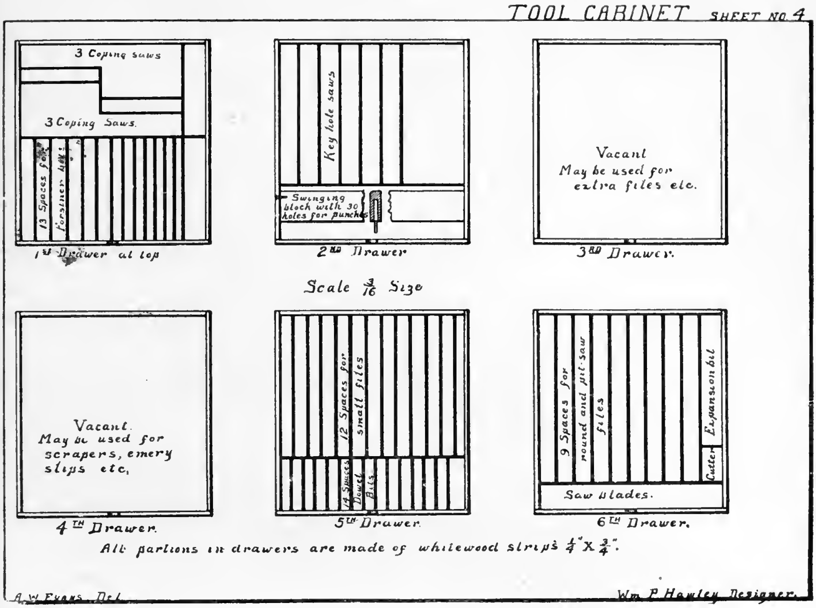

DETAILS OF GRINDSTONE REST.
Finish at F.
F
10"
6"
1/2" Drill
5/16" Tap
3/8" Tap
1/2" Tap
7/16" Core
1/2" Drill
3/8" Drill
3/8" R
John H. Toomey Des.

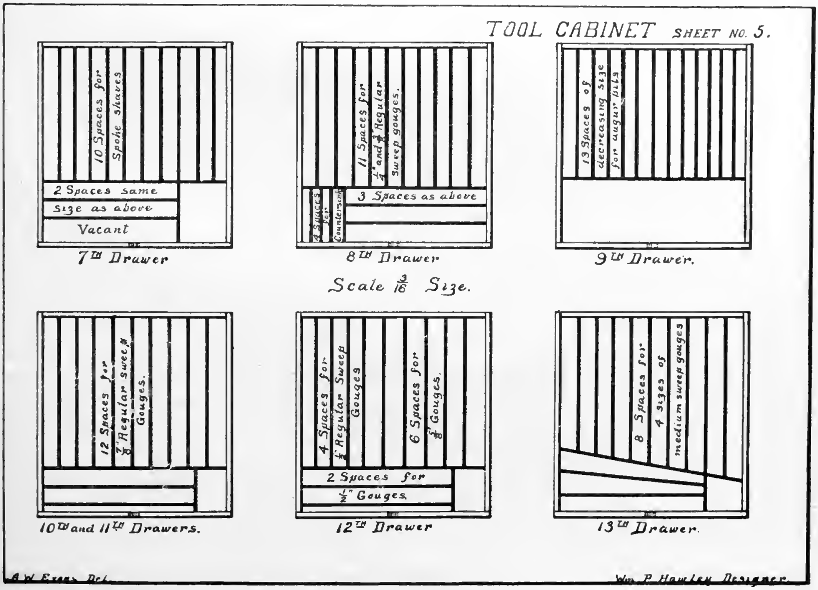

LOCKER CASE.
3 ft.
3 ft.
2 ft.
2 ft.
2 ft.
2 ft.
$2\frac{1}{2}$"
18"
4"
7 ft.
6 ft. $2\frac{5}{8}$"
A
B.
Dowells
Section on line A B.
Provide Case with 6 locks Corbin No. $0685\frac{1}{2}$ to fit masterkey of pupils bench.
Also 6 elbow latches (spring No. 6300. Stock Ash.
Finish with light filler shellac and one coat Waring Coach Varnish.
This work to be guaranteed not to shrink or warp for one year.
A. W. Evans Del.

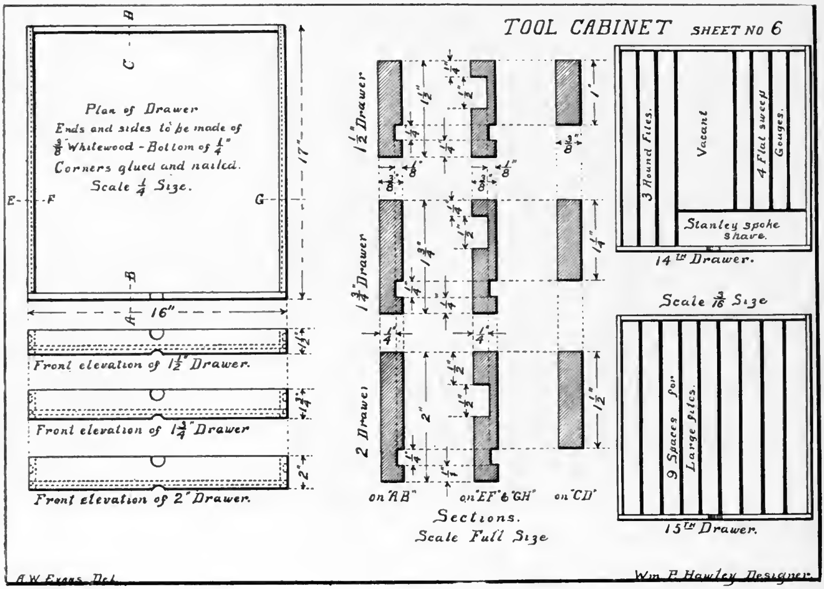

TOOL CABINET SHEET No. 1.
Forstner bits
Coping saws
Carving punches
Key-hole saws
Small Files
Dowel bits
Round files
Half-round files
Expansion bit
Spoke-shaves
$\frac{1}{4}$ and $\frac{3}{8}$" Regular Gouges
Countersinks
8
9
Regular gouges 10
$\frac{7}{8}$ Regular gouges 11
$\frac{1}{2}$ Regular gouges
$\frac{5}{8}$ Regular gouges 12
Large Files 15
A. W. Evans Del.
Wm. P. Hawley Designer

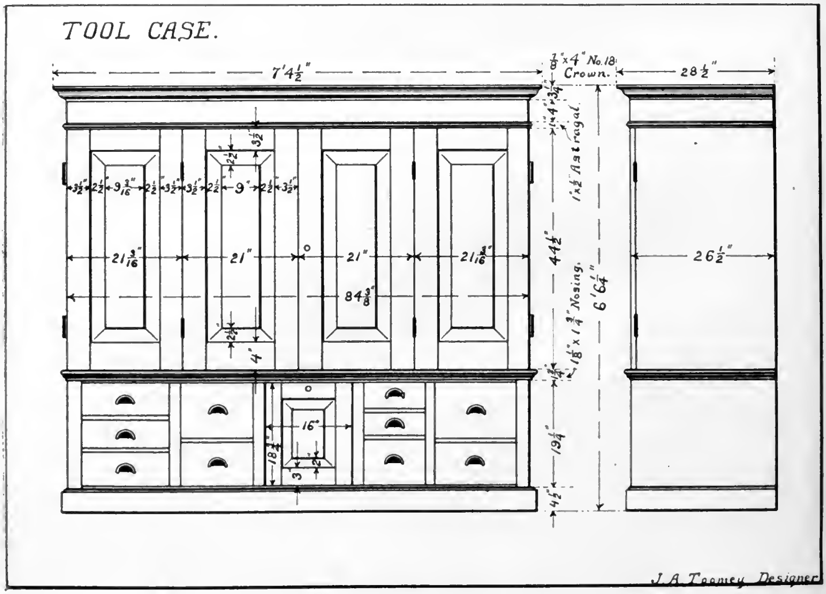

TOOL CABINET SHEET NO 2
Section on "AB" showing door
A
B
Drawer slides 3/8" X 1/2" let into sides 1/8"
Case to be built of 1/2" stuff with top and bottom of 7/8"
Dimensions 26 3/4" X 16" X 17" deep inside.
Horizontal Section.
Drawer slide.
Section of slide.
17"
16"
Scale 1/4 Size.
A W Evans Del.
Wm P Hawley Designer.


TOOL CABINET SHEET NO 3
7/8"
16"
Make 4 like this.
Make 5 like this
Make 6 like this
16 5/8"
Make 8 like this.
Make 10 like this.
Make 12 like this.
15 1/4"
Make 4 like this
Make 5 like this.
Make 6 like this
16 3/4"
Make 15 like this
Scale 1/4 Size
Grain running thus
15 1/2"
A W Evans Del.
Wm P Hawley

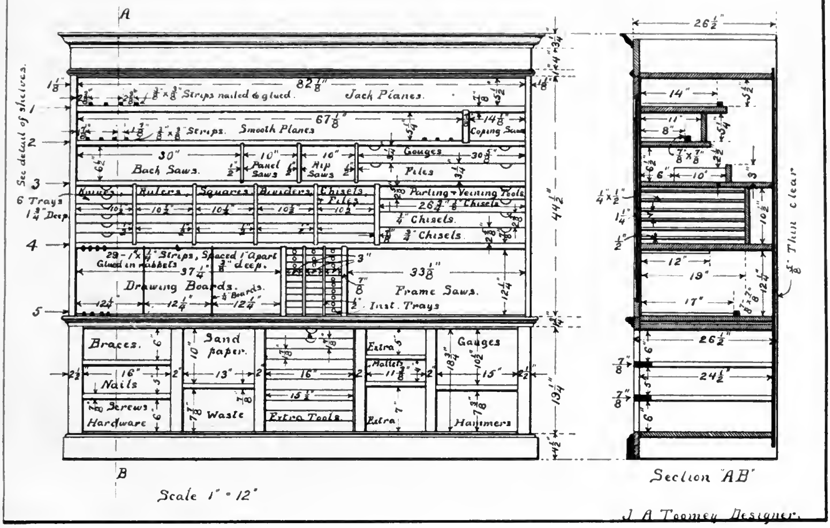

TOOL CABINET SHEET NO. 4
3 Coping saws
3 Coping Saws.
13 Spaces for forstner bits
1st Drawer at top
Key hole saws
Swinging block with 30 holes for punches
2nd Drawer
Vacant
May be used for extra files etc.
3rd Drawer.
Scale 3/16 Size
Vacant.
May be used for scrapers, emery slips etc.
4th Drawer.
12 Spaces for small files
14 Spaces Dowel Bits
5th Drawer.
9 Spaces for round and pit-saw files
Expansion bit
Cutter
Saw blades.
6th Drawer.
All partions in drawers are made of whitewood strips 1/4" X 3/4".
A. W. Evans Del.
Wm P. Hawley Designer.


TOOL CABINET SHEET NO. 5.
10 Spaces for Spoke shaves
2 Spaces same size as above
Vacant
7th Drawer
11 Spaces for 1/4" and 3/8" Regular sweep gouges.
4 Spaces for Countersinks
3 Spaces as above
8th Drawer
13 Spaces of decreasing size for augur bits
9th Drawer.
Scale 3/16 Size.
12 Spaces for 7/8" Regular sweep Gouges.
10th and 11th Drawers.
4 Spaces for 1" Regular Sweep Gouges
6 Spaces for 5/8" Gouges.
2 Spaces for 1/2" Gouges.
12th Drawer
8 Spaces for 4 sizes of medium sweep gouges
13th Drawer.
A. W. Evans Del.
Wm P. Hawley Designer.

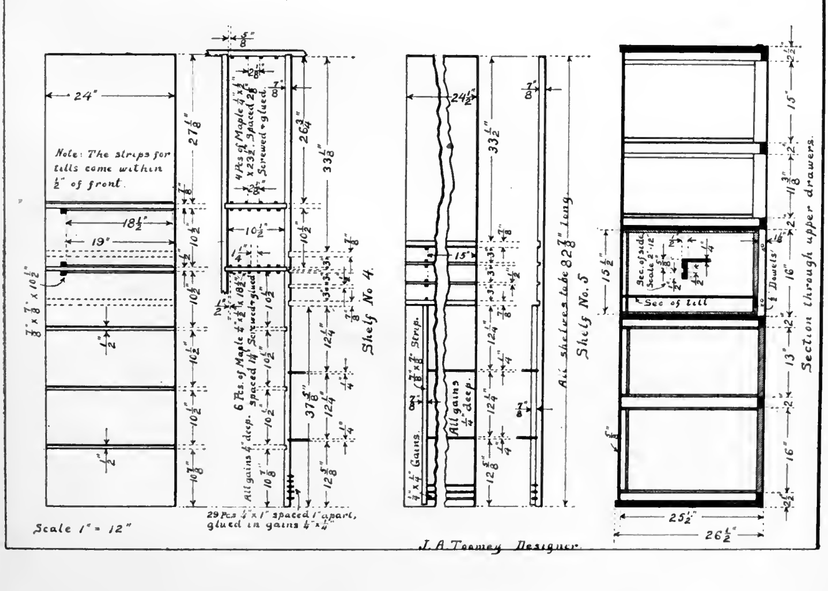

TOOL CABINET SHEET NO 6
Plan of Drawer
Ends and sides to be made of $\frac{3}{8}$" Whitewood - Bottom of $\frac{1}{4}$"
Corners glued and nailed.
Scale $\frac{1}{4}$ Size.
17"
16"
Front elevation of $1\frac{1}{2}$" Drawer.
Front elevation of $1\frac{3}{4}$" Drawer
Front elevation of 2" Drawer.
$1\frac{1}{2}$" Drawer
$1\frac{3}{4}$" Drawer
2 Drawer
on "AB"
on "EF" & "GH"
on "CD"
Sections.
Scale Full Size
3 Round Files.
Vacant
4 Flat sweep Gouges.
Stanley spoke shave.
14th Drawer.
Scale $\frac{3}{16}$ Size
9 Spaces for Large files.
15th Drawer.
A.W. Evans Del.
Wm. P. Hawley Designer.

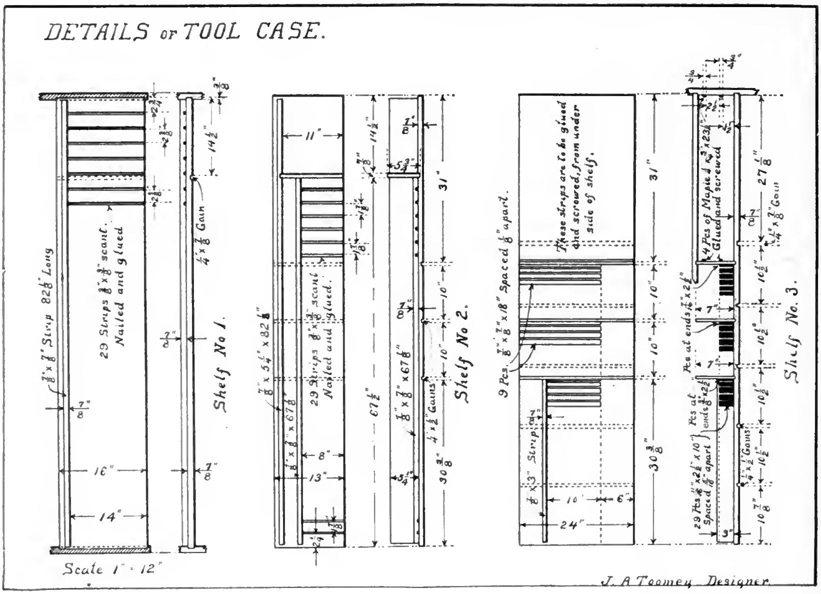

TOOL CASE.
7'$4\frac{1}{2}$"
$\frac{7}{8}$"x4" No.18 Crown.
$28\frac{1}{2}$"
$1\frac{1}{4}$"x$\frac{1}{2}$" Astragal.
$21\frac{3}{16}$"
21"
21"
$21\frac{3}{16}$"
$84\frac{3}{8}$"
$44\frac{1}{2}$"
$1\frac{1}{8}$"x$1\frac{3}{4}$" Nosing.
6'$6\frac{1}{4}$"
$26\frac{1}{2}$"
16"
$18\frac{1}{2}$"
$19\frac{1}{4}$"
$4\frac{1}{2}$"
J. A. Toomey Designer.

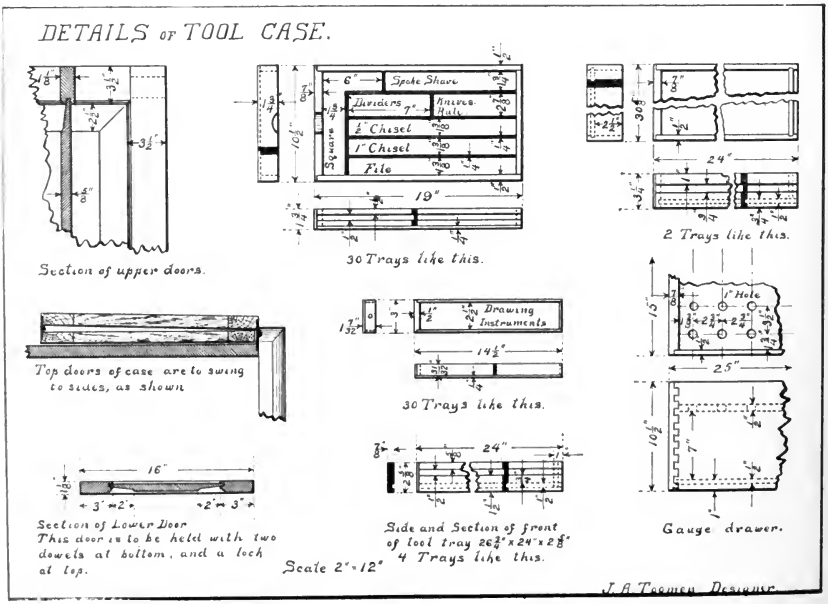
TOOL CASE.



DETAILS OF TOOL CASE.




DETAILS OF TOOL CASE.
29 Strips 1/8" x 7/8" scant. Nailed and glued
Shelf No 1.
Shelf No 2.
Shelf No. 3.
These strips are to be glued and screwed, from under side of shelf.
Scale 1" = 12"
J. A. Toomey Designer


DETAILS OF TOOL CASE.
Section of upper doors.
Spoke Shave
Dividers
Knives. Rule
1/2" Chisel
1" Chisel
File
Square
30 Trays like this.
2 Trays like this.
Drawing Instruments
30 Trays like this.
1" Hole
Gauge drawer.
Top doors of case are to swing to sides, as shown
Section of Lower Door
This door is to be held with two dowels at bottom, and a lock at top.
Side and Section of front of tool tray 26 3/4" x 24" x 2 5/8"
4 Trays like this.
Scale 2" = 12"
J. A. Toomey Designer

LIST OF TOOLS PROVIDED FOR IN TOOL CASE.

30 T. Squares.
30, 45° Triangles.
30, 30° Triangles.
30 Drawing Boards.
30 Instrument Trays.
30 Smooth Planes.
30 Jack Planes.
30 Back Saws.
10 Panel Saws.
10 Rip Saws.
30, 12″ Frame Saws.
30 Coping Saws.
30 Hammers.
10 Mallets.
10 Braces.
10 Screwdrivers.
30 Dividers.
30 Rulers.

30 Trysquares.
30 Chip-carving Knives.
30 Whittling Knives.
30, 1″ Chisels.
30, ½″ Chisels.
60 Files.
30 Marking Gauges.
30, ⅛″ Chisels.
30, ¼″ Chisels.
30, ¾″ Chisels.
30, ⅞″ Gouges.
30 Parting Tools.
30 Veining Tools.
30 Spoke Shaves.
10 Oilers.
10 Emery Stones.
Sandpaper.
Waste and Extra Tools.

SPECIFICATIONS FOR TOOL CASE.

WOODWORK.

Tool cases to be constructed as per drawings accompanying these specifications.

The body of the cases to be made of clear Yellow Pine throughout, except the stiles and rails of doors, which are to be made of "A Select" White Pine. Doors to be made with raised panels and stiles and rails to be moulded, as shown in drawings, all to be mortised, glued and wedged together.

All shelves, tills, partitions, backs, sides, bottoms of drawers to be made of clear straight grained Poplar. All shelves are to be made 7/8" thick and no dado is to be cut deeper than 1/4". The shelves are to be set into dados in sides 3/8" deep. A clearance of 1/2" to be allowed between fronts of shelves and inside of doors.

All partitions between shelves are to extend to the back of the case unless shown otherwise in the drawings. The grain of the wood in partitions is to run vertically. Drawers are to be dovetailed and glued together.

All tills are to be put together, as shown in drawings, and all joints are to be glued and nailed together. Slides for tills are to be made of Maple and are to be fastened with glue and screws to partitions. Cases are to be provided with No. 18 7/8" x 4" crown mould, 1" x 1/2", No. 136, astragal and 1 1/8" x 1 3/4", No. 156, nosing, all Yellow Pine, and are to be closed in on back with 5/8" "thin clear" ceiling, D. M. B. 1 side.

All work to be smoothly dressed and sandpapered and properly prepared for oil finish.

HARDWARE.

The outside doors are to be hung with 4" x 4", and middle doors with 3" x 3", extra heavy, fast joint brass butt hinges, No. 100 Orr & Lockett's Catalogue. They are also to be provided with six (6) wrought iron flush bolts, 1" x 6", No. 1026 Orr &

Lockett's Catalogue. The Dietz lock No. 78, for 1⅛″ wood, is to be put on upper and lower doors and three (3) keys are to be furnished with each lock. Drawers are to be provided with Corbin lock No. 452, with same keys for all locks. Instrument trays are to be provided with No. 801, (½″) half inch bronze shutter knobs.

OIL FINISHING.

Woodwork is to be finished with one (1) coat of "D. C." or "V. S. O." pure gum orange shellac (Shellac to be cut in ninety-five per cent. pure grain alcohol, 3½ pounds to the gallon) and two (2) coats of varnish (varnish to be of the best grade as manufactured for the specific purpose by one of the following manufacturers: Berry Bros. Elastic Interior Finish; Chicago Varnish Co.'s Shipoleum; F. W. Devoe & Co. Interior Durable Wood Finish; Murphy Varnish Co. Transparent Wood Finish, Interior; Pratt & Lambert No. 38 Preservative; The Glidden Varnish Co. Pale Elastic Interior; Watts, De Golyer Co. Elastic Interior; Queen City Elastic Inside Finish.) All work to be sandpapered between coats, and each coat of varnish to be thoroughly rubbed with powdered pumice-stone and rubbing oil. Bidders must state in their proposal the kind of varnish they intend to use.

Chicago Public Schools.

PROGRAM.

MANUAL TRAINING DEPARTMENT.

....*School.*

TIME.	8.30 — 10.00	10.30 — 12.00	1.00 — 2.30	2.30 — 4.00
Monday.	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......
Tuesday.	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......
Wednesday.	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......
Thursday.	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils......
Friday.	Rm. | Gr. School No. of pupils......	Rm. | Gr. School No. of pupils	Rm. | Gr. School No. of pupils.....	Rm. | Gr. School No. of pupils ....

REPORT BLANK.

MANUAL TRAINING DEPARTMENT.

Report to Principal of .... *School.*

Grade .... *Time* .... *Chicago,* .... *189* ....

ABSENT.	TARDY.
....	....
....	....
....	....
....	....
....	....
....	....
....	....

Remarks: ....

....

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This blank is to be used for no purpose other than Reports to Principals.

.... *Teacher.*

Manual Training Dep't .... *School.*

Board of Education,
City of Chicago.

INVENTORY.

MANUAL TRAINING EQUIPMENT.

In the..*School.*

....*18*..........

Note.—Teachers in charge of Manual Training Shops will make report, on this form, of all tools and apparatus under their care. This report is to be returned to the Supervisor of Manual Training on or before the date above given.

Number in Shop.	ARTICLES.	Approximate Price Each.	Remarks.
	Blackboard Compass	$1 25	....
	T Squares	25	....
	30° Triangles	25	....
	45° Triangles	25	....
	Drawing Boards..................	75	....
	Rubber Pencil Erasers	08	....
	Pencil Compasses (German Silver)..	40	....
	Instrument Trays	......	....
	Drawing Rules....................	05	....
	Counter Brushes	50	....
	Whisk Brooms....................	15	....
	Double Benches (including vises) ..	30 00	....
	Teachers' Benches (including vises) ..	40 00	....
	Four Pupil Benches (including vises).	20 00	....
	Six Pupil Benches (including vises)..	30 00	....
	Locker Cases	30 00	....
	Bench Hooks	25	....
	Strops	15	....
	No. 2 Smoothing Planes	1 22	....
	No. 5 Jack Planes................	1 53	....
	No. 6 Fore Planes	1 94	....

INVENTORY—Continued.

Number in Shop.	ARTICLES.	Approximate Price Each.	REMARKS.
	No. 18 Block Planes	72	....
	No. 60 Block Planes	72	....
	No. 140 Block Planes	83	....
	No. 45 or 55 Rabbet Planes	8 50	....
	Back Saws	86	....
	Panel Saws	1 36	....
	Rip Saws	1 50	....
	Miter Box....	7 00	....
	14″ Turning Saws	90	....
	12″ Turning Saws..................	90	....
	Pad or Keyhole Saws	25	....
	Coping Saws	20	....
	Saw Vise.........................	80	....
	Saw Set..........................	75	....
	Cabinet Scrapers.................	20	....
	Hammers	35	....
	Mallets, Rubber	75	....
	Hatchets	50	....
	Augur Bits in case, Set	4 00	....
	Dowell Bits	20	....
	Forstner Bits (¼″ to 1″), Set	7 00	....
	Braces (common).................	75	....
	Braces (rachet)..................	1 25	....
	Automatic Boring Tool	1 25	....
	Expansive Bit	1 00	....
	Brace Drills, Set.................	75	....
	Screwdrivers	25	....
	Screwdriver Bits	10	....
	Nail Sets	10	....
	Countersinks	20	....
	Bit Gauges	25	....
	Dividers	32	....
	Framing Squares..................	50	....

INVENTORY—Continued.

Number in Shop.	ARTICLES.	Approximate Price Each.	REMARKS.
	Rules No. 61	10	
	T Bevels	30	
	Try Squares	25	
	Marking Gauges	25	
	Panel Gauges	50	
	Splitting Gauge	30	
	Monkey Wrench	50	
	Iron Cabinet Clamps		
	Wood Hand Screws	50	
	1/8" Chisels	40	
	1/4" Chisels	40	
	3/8" Chisels	40	
	1/2" Chisels	45	
	5/8" Chisels	45	
	3/4" Chisels	50	
	7/8" Chisels	50	
	1 " Chisels	55	
	1 1/2" Chisels	80	
	2 " Chisels	1 00	
	1/4" Gouges, Regular	30	
	3/8" Gouges, Regular	30	
	5/8" Gouges, Regular	35	
	7/8" Gouges, Regular	40	
	1/2" Gouges, Medium	35	
	3/4" Gouges, Medium	40	
	1 1/4" Gouges, Medium	50	
	1/2" Gouges, Flat	35	
	3/4" Gouges, Flat	40	
	1 " Gouges, Flat	50	
	1 1/4" Gouges, Flat	50	
	Bit Files	15	
	Flat Files	20	
	Saw Files	10	

INVENTORY—Continued.

Number in Shop.	ARTICLES.	Approximate Price Each.	Remarks.
	Half Round Files	20	....
	Round Files......................	15	....
	File Card and Brush...............	25	....
	Carving Punches..................	15	....
	Cutting Plyers....................	1 50	....
	Parting Tools.....................	35	....
	Veining Tools	50	....
	Spoke Shaves.....................	75	....
	Oilers	10	....
	Oil Fillers.......................	40	....
	Arkansas Oil Stones.	1 50	....
	Washitaw Oil Stones	50	....
	Emery Oil Stones.................	50	....
	Gouge Slips	10	....
	Triangular Slips	10	....
	Steel Letters and Figures...........	3 00	....
	Stencil Letters and Figures, 1½"....	1 25	....
	Chip-carving Knives	20	....
	Whittling Knives..................	20	....
	Grindstone	20 00	....
Add	such items as are not indicated above.		

.... *Teacher.*

SIGN HERE.

SUPPLIES

FURNISHED TO SHOPS OF THE

MANUAL TRAINING DEPARTMENT,

IN THE

ELEMENTARY SCHOOLS.

The following articles are kept in stock at the Supply Department for the use of the Manual Training Shops, and will be furnished upon requisition of the Manual Training Teachers, approved by the Supervisor of Manual Training.

Supplies (including Lumber, Sundries and Tools) to the maximum amount of One Hundred Dollars ($100.00) will be furnished to each shop. The cost of all items of supplies is appended to this list. Teachers are cautioned to so regulate their orders that they may never be in danger of overdrawing the allowance.

Teachers are to make requisition for supplies at least ten days in advance of requirement. Requisitions for supplies **ON THIS LIST** are to be specified in accordance with the list, on the regular requisition blanks of the Board, and are to be sent to the Supervisor of Manual Training, Schiller Building. All items **NOT FOUND IN THIS LIST** are to be specified on separate requisition blanks.

A COPY of each requisition is to be made upon the stubs provided for that purpose in the requisition books.

SUNDRIES.	Cost.	Per.
Requisition Blank Books....................		
Drawing Paper, 10" x 13½" (packages of 100 sheets).	$0 10	100 sheets
Kite Paper (colored)	17	100 sheets
Strawboard (sheets No. 60, 13" x 12¾").....	20	100 sheets
Report Blanks..............................	10	pad
12" Drawing Rulers	05	each
2' No. 61 Rules............................	05	each
Drawing Compasses..........................	40	each
Thumb Tacks................................	15	100

SUNDRIES—Continued.	Cost.	Per.
Rubber Pencil Erasers	$0 08	each
Lead Pencils No. 1 (gross boxes)		
Lead Pencils No. 3 (gross boxes)		
Cotton Waste		pound
No. 18 Twine (Balls)	08	ball
Sand Paper No. 1	10	quire
Sand Paper No. 0	10	quire
Kerosene Oil (2 gallon cans)		
Machine Oil " "		
Turpentine " "	50	gallon
Shellac, White or Orange (2 gallon cans)	2 20	gallon
Alcohol Oil (2 gallon cans)	2 40	gallon
Empty cans are to be returned to the delivery wagon upon receipt of a fresh supply.		
Lamp Black (½ lb. packages)	08	pound
Putty (10 lb. skins)	35	skin
Graphite (¼ lb. boxes)	10	box
Pumice Stone, F. F. (10 lb. packages)	15	package
Polishing Felt (pieces 5" x 3")	25	each
Wood Filler, Light Oak (5 lb. cans)	35	can
Wood Filler, Rosewood "	35	can
Wood Filler, Mahogany "	35	can
Drop Black (1 lb. cans)		can
Floor Wax "		can
Water Stain, Mahogany (⅛ lb. cans)	12	can
Water Stain, Walnut "	12	can
Water Stain, Rosewood "	12	can
Water Stain, Green "	12	can
Glue (¼ and 1 gallon cans)	1 75	gallon
Glue Brushes No. 000	10	each
1" Varnish Brushes (glue set, are not to be placed in water)	21	each
1½" Varnish Brushes " " "	32	each
Nails, Wire, Casing, 2d, (5 lb. boxes)	05	pound
Nails, Wire, Casing, 4d, "	04	pound
Nails, Wire, Casing, 6d, "	04	pound
Nails, Wire, Casing, 8d, "	03	pound
Brads, Wire, ½" (2 lb. boxes)	07	pound

SUNDRIES—Continued.	Cost.	Per.
Brads, Wire, 5/8" (2 lb. boxes)	\$0 06	pound
Brads, Wire, 3/4" "	04	pound
Vise Handles	10	each
Surgeons Adhesive Tape (in rolls)	30	roll
Chest Locks	10	each
Escutcheons for Chest Locks	01	each
Chest Handles	05	each
2 1/2" Steel Butt Hinges	03	each
Brass Hinges, Fancy, No. 6	01	each
Brass File Hinges, 3/8" x 2 3/8"	02	each
Brass Butt Hinges, 1/2" Middle	01	each
Brass Butt Hinges, 3/4" Middle	01	each
Brass Butt Hinges, 1" Narrow	02	each
Brass Butt Hinges, 3/4" Desk	02	each
Fancy Brass Hinges No. 1, for Glove Box	02	each
Brass Drawer Locks No. 0601	50	each
Brass Drawer Locks No. 0601 1/2 (spring)	50	each
Looking Glass Plates No. 877	02	each
Stove Bolts, 1 1/4" x 1/4"	10	dozen
14" Turning Saw Blades	14	each
12" Turning Saw Blades	14	each
1/4" Dowel Rods (36" long)	01	each
3/8" Dowel Rods "	01	each
1/2" Dowel Rods "	01	each
5/8" Dowel Rods "	01	each
3/4" Dowel Rods "	01	each
3/8" Escutcheon Pins, Brass, No. 18 (1/4 lb. boxes)	10	box
1/2" Escutcheon Pins, Brass, No. 18 "	10	box
5/8" Escutcheon Pins, Brass, No. 16 "	10	box
3/4" Escutcheon Pins, Brass, No. 14 "	10	box
Varnish Cups	30	each
No. 100 Coping Saw Frames	20	each
Blades for Coping Saws	01	each
F. H. Bright Wood Screws, 1/2", No. 4 (gross boxes)	09	gross
F. H. Bright " 5/8", " 4 "	09	gross
F. H. Bright " 3/4", " 6 "	11	gross

SUNDRIES—Continued.	Cost.	Per.
F. H. Bright Wood Screws, ¾", No. 8 (gross boxes)	$0 13	gross
F. H. Bright " ⅞", " 8 "	13	gross
F. H. Bright " 1 ", " 8 "	15	gross
F. H. Bright " 1 ", " 10 "	15	gross
F. H. Bright " 1¼", " 8 "	16	gross
F. H. Bright " 1¼", " 10 "	20	gross
F. H. Bright " 1½", " 10 "	19	gross
F. H. Bright " 2 ", " 12 "	24	gross
F. H. Brass Wood Screws, ⅜", " 1 "	25	gross
F. H. Brass Wood Screws, ½", " 3 "	25	gross
F. H. Brass Wood Screws, ¾", " 4 "	25	gross
No. 108 Screw Hooks (gross boxes).........	55	gross
No. 111 Screw Hooks "	40	gross
No. 108 Screw Eyes "	32	gross
No. 111 Screw Eyes "	25	gross
Brass Hooks and Eyes No. 61, ¾" (dozens) .	05	dozen
Brass Screw Hooks No. 412, ⅝" (gross boxes)	40	gross
Brass Screw Eyes No. 1113, ⅝" "	30	gross
Brass Drop Catches No. 782 (¼ gross boxes).	02	each
Wire Screw Hooks No. 6 (for coat hangers)..	25	gross
Sash Knobs No. 105, ⅜"..................	01	each
Malleable Corner Braces..................	01	each
Bottoms for No. 2 Plane..................	50	each
Bottoms for No. 5 Plane..................	60	each
Handles for No. 2 Plane..................	15	each
Handles for No. 5 Plane..................	15	each
Frogs for No. 2 Plane..................	18	each
Frogs for No. 5 Plane..................	18	each
Knobs for No. 2 Plane..................	06	each
Knobs for No. 5 Plane..................	06	each
Blades for No. 2 Plane..................	20	each
Blades for No. 5 Plane..................	20	each
Clamps for No. 2 Plane..................	15	each
Clamps for No. 5 Plane..................	20	each
Screws for Plane Blades..................	05	each
Thumb Screws for Dividers..................	05	each

SUNDRIES—Continued.	Cost.	Per.
Thumb Nuts for Dividers....................	\$0 05	each
Wings for 6″ Dividers.......................	05	each
Wings for 7″ Dividers.......................	05	each
Shoulder Screws for Wood Hand-screws, No. 6 or 10	15	each
Back Screws for Wood Hand-screws, No. 6 or 10.	15	each
Thumb Screws for Marking Gauge...........	03	each
Brass Shoes for Marking Gauge.............	03	each

LUMBER.

8″ x 6′ = 4′ board measure.

Requisitions for lumber are to be made upon blanks separate from requisitions for all other supplies.

	Cost Per Piece.
1 ″ x 8 ″ x 6′, rough Pine	$0 16
7/8″ x 8 ″ x 6′, S. 2 S. Pine	16
1/2″ x 8 ″ x 6′, " Pine	20
1/4″ x 8 ″ x 6′, " Whitewood	19
3/8″ x 8 ″ x 6′, " Whitewood	16
5/8″ x 8 ″ x 6′, " Whitewood	18
1/8″ x 10 ″ x 6′, " Basswood	08
3/16″ x 10 ″ x 6′, " Basswood	08
1/4″ x 8 ″ x 6′, " Q. S. Oak	15
3/8″ x 8 ″ x 6′, " Q. S. Oak	15
1/2″ x 8 ″ x 6′, " Q. S. Oak	20
7/8″ x 8 ″ x 6′, " Q. S. Oak	20
1/4″ x 8 ″ x 6′, " Maple (soft)	10
1/2″ x 8 ″ x 6′, " Maple (soft)	16
7/8″ x 8 ″ x 6′, " Maple (soft)	22
1/2″ x 8 ″ x 6′, " Gum (Red)	22
7/8″ x 8 ″ x 6′, " Gum (Red)	30
3/8″ x 8 ″ x 6′, " Spanish Cedar, for Lantern Slide Frames	20
1/16″ x 6 ″ x 20″, S. 2 S. White Holly (dyed), Black, Red, Yellow, Green and Blue, for inlaying and built-up work	$0 10
1/2″ x 5 ″ x 21″, S. 2 S. Pine, for Towel Roller	02
1 1/4″ x 1 1/4″ x 20″, rough Gum, for Towel Roller and Tipcat	02
1 ″ x 2 ″ x 12″, rough Pine, for Pen Tray	01
1 ″ x 3 ″ x 12″, rough Gum, for Pen Tray	02
7/8″ x 10 ″ x 37″, S. 2 S. Pine, for Sled	10
1/2″ x 13 ″ x 30″, " Whitewood, for Sled	13
1 ″ x 1 ″ x 14″, rough Ash, for Sled	01
2 ″ x 3 ″ x 10″, S. 4 S. Birch, for Sugar Scoop	04
1 ″ x 3 ″ x 6′, rough Hickory, for Bows and Arrows	09

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