TOOL MANUAL FOR SCHOOL SHOPS

DISSTON

H. D. Glasgow

DISSTON TOOL MANUAL

for

School Shops

A Book of Practical Information on the Construction, Use, and Care of Saws, Tools, and Files.

HENRY DISSTON & SONS, Inc.

PHILADELPHIA, U. S. A.

Price.......................... $2.00

Instructors, supervisors, directors, principals or superintendents, actively interested in shop work who request the book, on school stationery, will receive a complimentary copy.

HENRY DISSTON

Foreword

To the Teachers of Our Boys

Henry Disston's greatest pride was in the craftsmen he made; in the saw-makers to whom he succeeded in imparting his ambition and his tirelessness for excellence.

The business that he founded still feels his influence. Its greatest pride is in the skill, loyalty, and character of its workers.

That is why we have taken more than ordinary interest in the preparation of this book. We have tried to write it so that it would contribute something toward the development of appreciation, character, and skill in those who are in your charge.

We should like you to feel that we understand some of the problems that face you, and that our own experiences have taught us to honor the patience and the perseverance that are the requirements of the work you do.

We give you friendly greeting, and if our book helps you even a little, it will have served its purpose.

Acknowledgment

To give credit to all directors and supervisors who have materially assisted us in the preparation of our manual would, of itself, exceed the limits of this book.

Your request for such a text, together with your counsels and criticisms during its preparation, are gratefully acknowledged.

Especially we express our appreciation to all whose willing aid and advice have deepened our understanding of industrial arts and vocational training.

May this book in your hands be ever an emblem of our desire to be helpful to you in your praiseworthy work.

Educational Dept.,
HENRY DISSTON & SONS, Inc.

Introduction

The purpose of this book is twofold:

First, it seeks to place in the hands of the instructor of Manual Arts an authoritative text on the theory and use of the tools that are most commonly used in modern schools.

Second, it offers to the instructor an organized method for teaching uses and purposes of the tools which the text discusses.

Some of the material used in this text has appeared previously. From the series known as "Disston Educational Aids" we have selected such historical descriptive matter which we believe would bear repetition.

For the great part, however, the contents are new. We hope that instructors will find it a well-rounded and useful treatment of the subjects which it embraces.

While many sections of the book will be interesting to pupils, the purpose throughout has been to provide primarily a reference work for the teacher.

It is suggested that the book be used for a series of lectures based upon the main chapters of the text.

We have compiled and edited this volume with great care, using every effort to make its contents correct and authoritative.

Henry Disston & Sons at all times will be ready and glad to advise you on any matter pertaining to the selection, care, and use of tools. Simply write our "Educational Department" and the time and assistance of our experts will be at your disposal, without obligating you in any way.

Contents

CHAPTER I

Equipping the School Shop

By ARTHUR F. HOPPER, A. M.

Section A

Typical Shops and Their Equipment

IT IS not so long since any basement room was considered good enough for the school shop irrespective of poor lighting, lack of space, facilities for obtaining electric current, gas, water, etc. Conditions have changed, however, and the modern educator gives as much thought to the location, equipment, and facilities for industrial arts work as he does for academic subjects.

It is not the purpose of this manual to discuss the advantages or disadvantages of various types of shops. Equipment and methods will necessarily vary according to the community, money available, and the person in charge of the work. On the other hand, a little information concerning some typical layouts, together with suggestions for equipment, may be of service to those contemplating new shops or the making of changes in old ones.

The first thing to be considered in planning a new shop is the type of work you contemplate doing. If the proposed shop is to be located in a vocational school, the problem is a comparatively simple one, inasmuch as it is now conceded that the work performed in a vocational school should be as far as possible a duplicate of that done in industry. The aim and objective is then clear cut—namely, the training of a pupil in some specific type of vocational work.

While the aims and objectives of manual arts are gradually taking more definite form, there is still much difference of opinion concerning methods of procedure. Teachers and others responsible for the development of this work can be divided into three fairly distinct groups:

1. Those who believe in the group method of instruction, with the emphasis on woodwork.

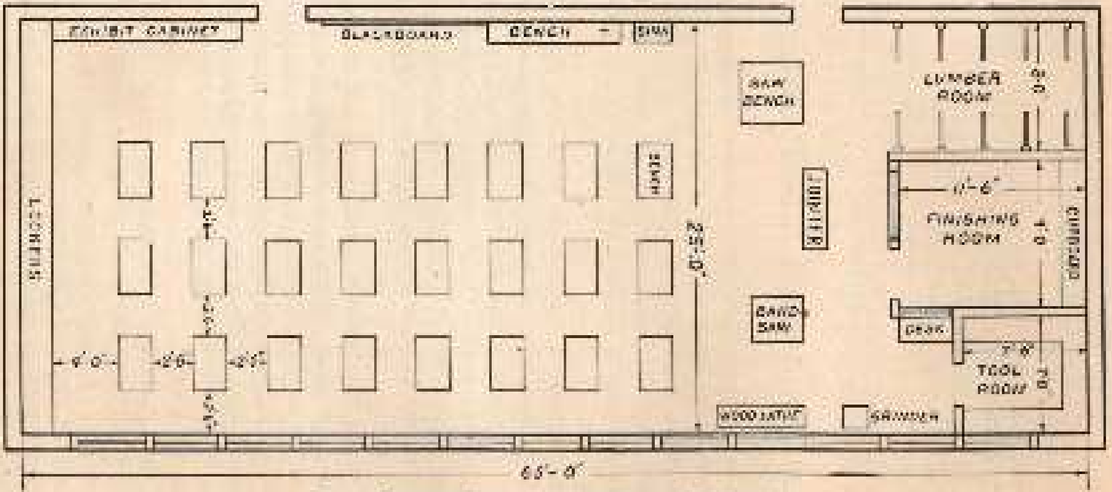


Fig. 1.—Suggested layout for 24-bench woodworking shop.

2. Those who believe in the group method, but in a greater variety of work, such as electrical and sheet metal work, etc., sometimes given in the form of short unit courses.

3. Those who are opposed to the group method of instruction, and favor the individual method as carried out in the diversified or composite shop plan, instead.

This third group might again be divided into those who favor carrying on simultaneously a large variety of activities, such as sheet metal work, woodwork, machine shop work, and electrical work, all in the one shop; and, on the other hand, those who limit activities to two or three subjects.

In many of the larger cities the group method described under 1 and 2 is still much in vogue, while the diversified scheme also has found favor in some cities.

Whichever plan you adopt, there are certain provisions that are now considered necessary for all modern shops, irrespective of whether you intend to use the group or individual method. It is essential that these be carefully considered when you are planning a new shop or remodeling an old one. For the sake of convenience they might be listed under the following headings:

1. **Ventilation.**—An adequate system of ventilation.

2. **Light.**—As much natural light as possible, with provisions for artificial light for dull days and evening school work. When placing benches and desks consider the direction and sources of light.

3. **Lighting Circuit.**—Provision to be made for several wall sockets for attaching electric soldering irons, glue pots, and light power machinery.

4. **Power Circuit.**—The power line should be heavy enough to take care of the total requirements of the equipment, and provision should be made for a suitable switchboard and box.

5. **Gas.**—There should be at least one gas connection.

6. **Water.**—Provision should be made for wash bowls in or near the shop and also for a drinking fountain in the shop room. A toilet just off the shop limits undue absence.

7. **Tool Room.**—Provision to be made for a tool room of not less than twenty-five square feet.

8. **Finishing Room.**—If the shop is to be used for cabinet work, provision should be made for a finishing room of not less than forty-five square feet.

9. **Lumber Rack.**—Adequate provision should be made for storing lumber.

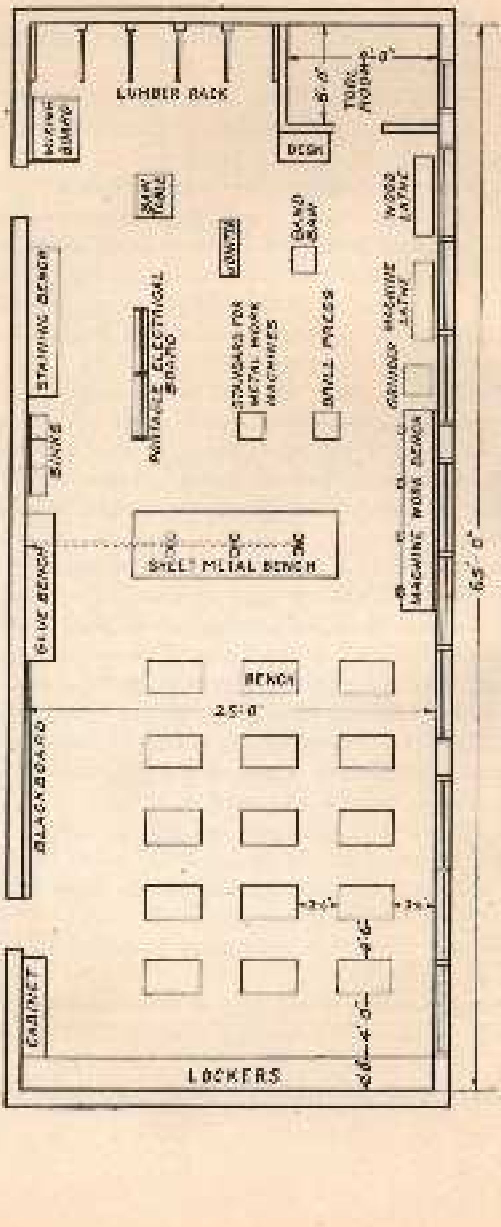


Fig. 2.—Suggested layout for general shop.

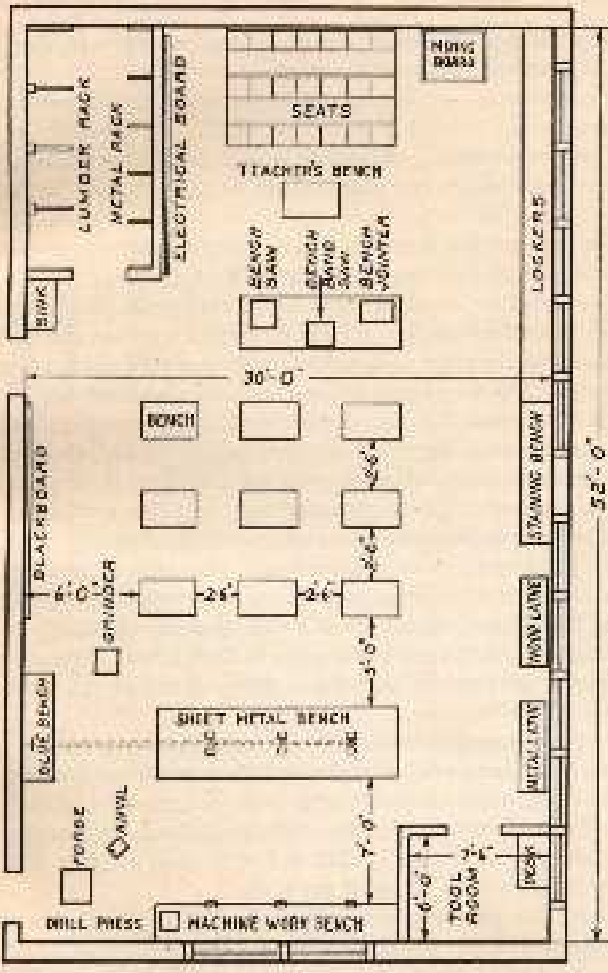


Fig. 3.—Suggested layout for composite shop.

10. **Lockers.**—Lockers, conveniently located in the shop, should be provided for all pupils. (This is one of the essentials of a modern school shop.)

11. **Cupboards.** Provision should be made for several good-sized cupboards for storage purposes.

12. **Blackboards.**—Provision should be made for adequate blackboard space.

13. **Teacher's Office.**—When space will permit, provision should be made for a teacher's room large enough to contain desk and bookcase, etc.

14. **Demonstration Room.**—Whenever possible there should be a demonstration room in connection with the shop; failing this, space might be provided for movable chairs in the shop itself.

Several State Departments of Public Instruction have issued bulletins giving suggestions for shop equipment, together with layouts of various types of shops. Wherever these are available they will be found of great assistance to those planning new shops or making changes in old ones.

An examination of these bulletins brings out the fact that we have not yet reached the stage where we can say that there is any standard plan of shop equipment. As a matter of fact, very few states have definite set plans or requirements, the matter of equipping and laying out shops being left largely to local educators. This lack of standards has resulted in hundreds of different plans, some of which show considerable thought and care in their development, while others are lacking in some of the essential things that go to make up a modern school shop. Without doubt, however, this freedom has led to a greater development than would otherwise have been the case.

Many school shops are inadequate in size. This is sometimes due to the fact that they were originally planned for a small number of pupils, no provision being made for future expansion and growth.

This oftentimes results in many difficulties for the instructor, such as lack of facilities for storing lumber and unfinished projects, or for assembling or finishing large pieces of work, etc.

Obviously, the planning and equipping of school shops is a matter that requires considerable thought and care.

On pages 12 to 15 will be found suggestive layouts for several types of shops. As previously intimated, personal opinions and local conditions will be the factors that will largely determine the particular plan of shop adopted.

Section B

The Selection of Woodworking Machinery

During the past few years woodworking machinery has become very popular in school shops; so much so that its selection, care, and upkeep is always more or less of a problem.

Until recently the majority of instructors of woodwork seems to have favored heavy types of machines, but lighter machines are now becoming popular, especially for elementary shops.

The selection of machinery requires a great deal of thought, and should be undertaken only after careful planning and consultation.

The following suggestions will be of service to those who contemplate installing machinery:

1. When in the market for machinery obtain bids from reliable sources on machines made by manufacturers of acknowledged standing.

2. Even though for the time being you only desire to purchase one machine, it is best to plan for your maximum equipment. The right sized conduit can then be run so that it will take care of your future needs.

3. Whenever possible buy machines with individual drives. This costs a little more in the beginning, but it is much more economical in the end. Moreover, it eliminates overhead shafting and belts that are always more or less dangerous and unsightly.

4. When asking for quotations on machinery always state whether A. C. or D. C. current; voltage; if A. C. current, number of cycles, etc. If you expect to install one or more of the lighter type of machines state whether or not you wish to run them from the lighting circuit or power circuit.

5. Take advantage of the educational departments of the manufacturers who specialize in machinery. If undecided about your equipment, write them stating your particular problem. They will be glad to assist you without obligation on your part.

Section C

Tool Equipment for School Shops

Whether you are ordering replacements or completely equipping a shop, there is one factor that should be borne in mind, namely, that the tools in a school shop necessarily have the hardest kind of wear.

They are in constant use by relatively inexperienced pupils and are handled by a number of different individuals, some of whom are sure to be careless. On account of these facts it is absolutely essential that the equipment be of the very highest grade, and the only way that this can be assured is to purchase standard tools from a reliable firm.

The skilful craftsman finds it impossible to do good work with inferior tools. Inexperience and lack of muscular control are enough of a

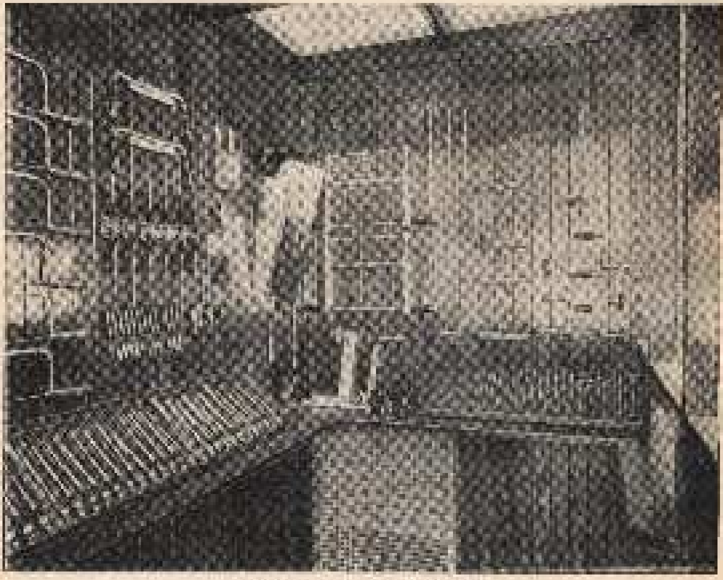


Fig. 4.—Interior of tool room.

handicap for the young people who work in school shops without the additional handicap of having to use tools that are always getting out of order.

Occasionally heads of departments and Boards of Education accept the lowest bids on equipment, relying on the explanation of the parties quoting, "that they are substituting another make other than the one called for," with the statement that it is "just as good," or, to use a much abused term, "equivalent." This usually proves to be mistaken economy.

The best plan is to write up your lists of the equipment required and definitely designate the name of tool with the brand or maker's name that you wish to purchase. The additional cost of standard, guaranteed tools is not great. In fact, in some cases they actually are cheaper than inferior substitutes, and when the wearing qualities of the well-made standard brand tool are taken into account, there is no question as to the advisability of insisting on standard makes.

Fig. 5.—Tools properly arranged on bench.

Considerable difference of opinion exists as to what constitutes a full equipment of tools. For instance, some teachers prefer to have a full set of chisels ranging in size from ⅛" to 2", while others consider it a much better plan to have a half dozen or a dozen of the sizes that are most generally used. It is now universally conceded that the individual bench equipment should be limited to as few tools as possible. This usually consists of a back saw, try square, marking gauge, jack plane, and rule. The general supply of tools is kept in the tool room.

Suggested Equipment for Woodworking Shops

The following list of tools is presented as a guide to those supervisors or instructors who are preparing lists of new or additional equipment for shops. As instructors develop their individual methods of presenting the subject of woodworking, their choice of equipment reflects the phases which they believe should be stressed. This specialization will result in a list of equipment best suited to your instruction. The suggested tools which we present will not be suited to every shop. They are, in the main, what we have found in some three hundred shops surveyed. If this list is helpful to some who are passing this way for the first time, to experienced but busy supervisors who want a standardized list, and to instructors who desire to check their equipment against a complete list, it will have more than served its purpose.

Individual Equipment.—By this is meant those tools most frequently used by the student and kept on the bench, in a drawer of the bench, or in a tool box issued to him each time he reports to the shop.

Back Saw, 12" (or 10") Disston No. 4
Try Square, 6" Disston No. 5½, square inside and outside
Marking Gauge, Disston No. 81, Ungraduated, Heavy Spur
Jack Plane, 11½" (or Junior Jack Plane)
Steel Rule, 12" or 24"
Bench Hook, maple (can be made)
Bench Duster

Additional Individual Equipment (as Preferred by Some Instructors).—Although most instructors are fairly well agreed on the articles given above as essential, they at times add the following to the individual bench equipment, placing it in the tool room or on the tool board. Experience will dictate your preference. If these tools are not added to the individual equipment, twelve to eighteen of them should be added to the general shop equipment.

Claw Hammer, Adze eye, 10 oz.
Screw-driver, 4", through tang, Disston No. 9.
Sloyd or Marking Knife, 2½" blade
Mallet, Hickory, round
Chisels, firmer, ¼" and ¾" socket or tang (or ½" and 1")

Note by department head of well-known schools: "I would provide in high school woodworking shops one set of chisels and plane blades for each pupil using the shop. This places responsibility for keeping tools sharp directly on the pupil."

Note by a supervisor: "The standard for equipment is not the bench, but the boy. We use one each of ¼", ½", and 1" chisels."

Note by a supervisor: "In my opinion there should be few if any tools on the bench. All tools are properly issued from the tool room."

Note by a director: "Large planes are too heavy for elementary work and jack planes are too long for most projects. I do not consider the hammer, mallet, and screw-driver essential for each bench."

Note by an instructor: "Hammers for 50% of the students are sufficient."

General Woodworking Tools.—This list is based on a twenty-four-bench shop. The quantity can be proportionally changed for smaller or larger shops.

Description

6 Hand Saws for cross-cutting, 22", 9 point, Disston No. 7 (straight back) or D-8 (skew back)
6 Hand Saws for ripping, 22", 7 point, Disston No. 7 or D-8
1 Mitre Box with 20" Disston Mitre Box Saw No. 4, 4" under back
3 Compass Saws, 12" Disston No. 2
2 Dovetail Saws, 8", 17 point, steel back, Disston No. 68
2 Keyhole Saws and Pads, Disston No. 95
6 Coping Saws, Steel Frame, Disston No. 10
1 Gross Coping Saw Blades, Disston No. 10 Special Steel
6 Jack Planes, 14"
2 Jointer Planes, 22"
1 Rabbet Plane, 8½"
2 Router Planes, 7½"
12 Plane Blades for Jack Plane (Extra) (or Junior Jack Plane), 1¾" wide
6 8" Smooth Planes
3 Block Planes, 5½"
6 Ratchet Braces, 8" Swing
1 Ratchet Brace, 10" Swing
6 Each Screw-driver Bits, ¼", ⅜", ½" Disston
6 Each Dowel Bits, ¼", ⅜", ½"
1 Dowel Pointer
1 Set Auger Bits, ¼" to 1" by 1/16s, double thread
3 Auger Bits, ⅝" Double Fine Thread

2 Auger Bits, ½" Course Single Thread
2 Auger Bits, ⅝" Course Single Thread
1 Dozen each Bit Stock Drills, ⅛" and ⅜"
½ Dozen each Bit Stock Drills, 3/32" and ¼"
1 Bench Drill
2 Hand Drills
6 Rose Countersinks, ½"
1 Expansion Bit, ½" to 1½"
1 Each Forstner Bit, ⅜", ½", and 1¼"
6 Firmer Chisels ¼" (Socket or Tang)
12 Firmer Chisels ½" (Socket or Tang)
12 Firmer Chisels 1" (Socket or Tang)
2 ¾" Firmer Chisels
6 Each Mortise Chisels, 5/16", ½"
3 Each Gouges Outside Bevel, ¼", ⅜", ¾" and 1"
1 Set of Gouges Inside Bevel, ⅛" to 1"
3 Gouges Inside Bevel, ½"
2 Mortise Gauges, Disston Boxwood, No. 96
3 Try Squares, Metal, 12" Disston No. 5½
1 Steel Square 24" x 16"
1 Mitre Square, 12" Disston No. 10
4 Sliding T Bevels, positive lock, 8" Blade Disston No. 3
6 Wing Dividers, 6" spring type
1 Monkey Wrench, 8"
1 Stillson Wrench, 12"
3 Each Brad Awls, 1" and 1½" Blade
1 Flat Nose Pliers, 5"
1 Combination Pliers, 8"
1 Nippers (pincers), end cutting 6"
1 Dozen Screw-drivers, through tang, Disston No. 9 (½ doz. 3", ⅓ doz. 5", ⅙ doz. 7")
2 Each Cabinet Screw-drivers, 3", 7", 10" Disston No. 31
1 Each Screw-driver, through tang, 8" and 12"—Disston No. 9
1 Screw-driver, insulated, Disston No. 50, molded rubber
6 Each Nail Sets, 1/32", 2/32", and 3/32"
6 Regular Taper Files, 6" Disston
6 Slim Taper Files, 5½" Disston
6 Extra Slim Taper Files, 5" Disston
6 Mill Bastard Files, 10" Disston

6 Hand Second Cut Files, 10" Disston
6 Half Round Bastard Files, 10" Disston
3 Round Bastard Files, 8" Disston
6 Cabinet Rasps, half round, 10" Disston
6 Flat Wood Files, 10" Disston
3 Dozen File handles, Disston (1 doz. No. 3, 2 doz. No. 2)
6 Cabinet Scrapers, 2½" x 5" ground edge, Disston
6 Cabinet Scrapers (3 Swan neck, 3 French), 3" x 6", Disston
1 Oval Burnisher Disston No. 0, 4½"
6 Auger Bit Files, flat and triangular points, Disston
2 File Card and Brush, Disston
6 Spoke Shaves, Iron
2 Each Band Saws, ¼", ¾", ½" Brazed to fit machine, Disston
1 Each circular Saws, rip and crosscut, to fit machine, Disston
1 Combination (rip and cross-cut) Circular Saw, for smooth cutting, to fit machine, Disston
1 Disston Keystone Groover or Ideal Groover to fit Circular saw mandrel
1 Pair Band Saw Brazing Tongs, Disston
1 Triumph Saw Set, No. 28 Disston
1 Dozen Practice Filing Pieces, 2½" x 6" Disston
1 Brazing Clamp for Band Saws up to 1" wide, Disston
1 Coil Silver Solder for Brazing Band Saws, Disston
1 Bottle Brazing Fluid, Disston
1 Hack Saw Frame, Adjustable, Disston No. 36½
2 Hack Saw Frames, No. 200, Disston 8"
1 Dozen Duraflex (flexible) Hack Saw Blades, 8" Disston
1 Plumb and Level 18" Adjustable, Disston No. 016
2 Web or Turning Saws, 14" x ⅝" complete, Disston
1 Dozen Turning Saw Blades, 14" x ½" Disston
3 India Combination Oil Stones (in iron box)
1 Set Hand Arkansas Slipstone (assorted)
2 Copperized Oilers, ½ pint
1 Set Steel Letters and Figures, ⅜"
4 Clamps, Steel Bar 4' 0"
2 Clamps, Steel Bar 5' 0"
1 Picture Frame Clamp
4 Each Carriage Makers' Clamps, 6" and 8"
18 Hand-screws (12–10" jaw and 6–12" jaw)
10 Clamps, Steel Bar, 36"

2 Dozen Pinch Dogs, ¾"
1 Glue Pot, Copper, electrically heated
1 Blow Torch
1 Tool Grinder, electrically driven
1 Pair Trammel Points
1 Glass Cutter
1 Pair 8" Tinners' Snips
1 Bench Vise 4"
12 Each Flat Varnish Brushes, hard rubber bound, 1" and 1½"
12 Flat Staining Brushes, Tin Bound, 1"

Suggested Equipment for Composite Shop

The number of different activities to be taught, the number of pupils to receive instruction, as well as the character of the work, will be the deciding factors in determining the equipment of this type of shop.

Woodworking (Composite Shop). The woodworking equipment for a composite shop is in general the same as that listed for a general woodworking shop excepting that the quantities will be regulated by the amount of woodworking to be done.

Sheet Metal Work (Composite Shop):

6 Mallets
6 Dividers 8"
6 Pr. Combination Pliers
6 Scratch Awls
6 Grooving Tools
6 Setting Hammers
6 Raising Hammers
6 Riveting Hammers
6 Pr. Straight Snips
2 Pr. Circular Blade Snips
6 Cold Chisels ⅝", Disston
2 Each Hollow Punches ⅛", ¾", 1"
6 Rivet Sets
6 Sets of Solid Punches
6 Marble Slabs
6 Acid Cups
6 Swabs or Brushes
6 Gas Furnaces

6 Pr. Soldering Coppers (1 lb. each)
1 Pr. Small Soldering Coppers
12 Soldering Copper Handles
6 Dishes for Dipping Solution
1 Pr. Nippers 10"
1 Cape Chisel ½" Disston
1 Anvil
1 Combination Square
1 Hand Drill
6 Bench Brushes
1 File Card and Brush, Disston
1 Hand Grinder
2 Oil Cans
1 6" Screw-driver Disston No. 9
1 8" Screw-driver Disston No. 9
1 Pr. Trammel Points
1 U. S. S. Gauge for Sheet and Plate Iron
1 Pr. Outside Calipers 6"
1 Pr. Inside Calipers 6"
1 Drill and Steel Wire Gauge
1 Hack Saw Frame Adj. Disston No. 36½
2 Hack Saw Frames—Low Back, Disston No. 200
2 Doz. Duraflex (flexible) Hack Saw Blades, Disston
2 Doz. Chromol (all hard) Hack Saw Blades, Disston
6 Mill Bastard Files 8" Disston
6 Mill Smooth Files, 8" Disston
6 Half Round Bastard Files 8" Disston
3 Round Bastard Files 8" Disston
3 Round Bastard Files 6" Disston
3 Flat Files (Second Cut) 10" Disston
3 Square Bastard Files 8" Disston
3 Three Square (Second Cut) Files 8" Disston
3 Doz. Assorted File Handles Disston No. 2 and 3
1 Circumference Rule
1 Steel Square 24"
1 Round Nose Pliers 6"
6 Steel Rules 12"
1 Handy Seamer
1 Bottom Stake Stationary Vise

1 Mandrel Stake
1 Hollow Mandrel Stake
1 Hatchet Stake
1 Square Stake
1 Blow-horn Stake
1 Double Seaming Stake
1 Candle Mold Stake
2 Bench Vises 4"

Sheet Metal Working Machines:

* 1 Hand Punch
* 1 Sheet Iron Folder
* 1 Wiring Machine
* 1 Setting Down Machine
* 1 Beading Machine
* 1 Pr. Crimping Rolls for Beading Machine
* 1 Pr. Elbow Edging Tools for Turning Machine
* 1 Squaring Shear
* 1 Turning Machine
* 1 Burring Machine
* 1 Double Seaming Machine
* 1 Slip Roll Forming Machine
* 1 Grooving Machine
* 1 Revolving Machine Standard
* 1 Brake
* 1 Circular Shears

Machine Shop Work (Composite Shop):

1 Set Center Punches ⅛" to ¼"
4 Machinists' Hammers 1 lb. and 1½ lb.
1 Set Morse Drills 1/16" to ½"
1 Tap and Drill Gauge
1 Drill and Steel Wire Gauge
1 Bench Drill Press
1 Surface Gauge
1 Depth Gauge
2 Inside Calipers 4" and 6"
2 Outside Calipers 4" and 6"
2 Pr. Spring Dividers
1 Pr. Transfer Calipers

* According to type of work.

1 Pair Trammel Points
2 Hack Saw Frames Adj., Disston No. 16¼
2 Hack Saw Frames Low Back, Disston No. 200
3 Doz. Duraflex Hack Saw Blades, Disston 8″
3 Doz. Chromol Hack Saw Blades, Disston 8″
2 Metal Countersinks
3 Steel Rules 6″
2 Hand Drills
1 Melting Ladle
1 Micrometer Caliper 1″
1 Center Gauge
1 Combination Square 12″ Complete
1 Thread Gauge
1 Thickness Gauge
1 Set of Taps and Dies $\frac{4}{36}$, $\frac{6}{32}$, $\frac{8}{32}$, $\frac{10}{24}$, $\frac{12}{24}$, $\frac{14}{20}$
1 Set of Taps and Dies ¼″ to ⅝″ U. S. S.
Tap Drills:
 ½ Doz. No. 41
 ½ Doz. No. 33
 ½ Doz. No. 28
 ½ Doz. No. 23
 ½ Doz. No. 15
 ½ Doz. No. 10
 ½ Doz. $\frac{13}{64}$″
 ½ Doz. ¼″
4 Bench Vises 4″
1 Small Furnace or Forge for tempering tools
1 Pr. Hermaphrodite Calipers 6″
1 Set Drive Pin Punches
1 Center Tester
6 Bench Brushes
1 Small Hand Vise
2 Scrapers
1 Grinder
1 Oil Stone
1 Indicator
1 Pr. V Blocks
1 Knurling Tool
2 Oil Cans

1 Boring Tool
1 Threading Tool
1 Pr. Tongs
1 Anvil
1 12" Screw-driver Disston No. 9
1 8" Screw-driver Disston No. 9
1 6" Screw-driver Disston No. 9
2 Parallel Lathe Dogs
1 Tool Holder ¼"
1 Tool Holder 5/16"
3 Each Cold Chisels ⅜", ⅝", ¾" Disston
3 Cape Chisels ¼", ⅜", ½" Disston
1 Flat File Second Cut 12" Disston
6 Mill Bastard Files 8" Disston
6 Mill Files, Smooth 8" Disston
6 Half Round Bastard Files 8" Disston
3 Round Bastard Files 8" Disston
3 Square Bastard Files 8" Disston
4 Slim Taper Files 6" and 8" Disston
3 Half Round Smooth Files 8" Disston
1 File Card and Brush Disston
3 Doz. File Handles Disston No. 2 and 3

Cement Work (Composite Shop):

2 Pails
2 Cementers' Trowels, 4" x 11" Disston No. 48
1 Pointing Trowel, 4½" Disston No. 15
1 Corner Trowel, 6," Disston No. 26
1 Cementers' Edging Trowel, 11", Disston No. 20
1 Watering Can
1 Level, 48" Disston No. 14½
1 Hand Float (can be made in shop)
1 Tamper (can be made in shop)
2 Shovels
1 Mixing Box (can be made in shop)
3 Measuring Boxes, ½, 1, and 2 cubic feet (can be made in shop)

Electrical Work (Composite Shop):

In view of the fact that the electrical work done in the average composite shop will be of a somewhat elementary character, no special tools will be required other than those already listed under woodwork and metal work.

Whenever more advanced work is to be undertaken, additional tools and equipment required will depend on the work contemplated.

Tools for Cement Work (15 Pupils):

10—Cementers' Finishing Trowels 4"x11" Disston No. 48
3—Cementers' Edging Trowels, 11" Disston No. 20
6—Pointing Trowels, 4½" Disston No. 15
6—Steel Squares, 24" blue finish
6—Hatchets
6—Claw Hammers—16-ounce
3—Sledge Hammers
2—Hand Saws, Rip 26", 6 point Disston No. 7 or D-8
2—Hand Saws, Cross-cut 26", 8 point Disston No. 7 or D-8
2—Double Duty Hand Saws 26", Disston D-17
2—Tin Snip 12"
2—Pliers 8"
3—Jack Planes
2—Brace and Bits
1—Crow Bar
2—Ripping Bars, Disston No. 82—24"
6—Brick Chisels 6" long, 4" face, Disston No. 88
6—Cold Chisels 5½" long ½" wide, Disston No. 80
6—Cold Chisels 9" long 1" wide, Disston No. 80
8—Shovels No. 1
2—Mattocks
6—Cement Edgers—Brass
6—Cement Jointers

CHAPTER II

Notes on Care of Tools and Equipment

By ARTHUR F. HOPPER, A. M.

Section A

Regarding the Care of Tools

A GOOD craftsman takes pride in keeping his tools in first-class condition at all times. The necessity for this must be impressed on every pupil who comes into the school shop. It is one of the first and most important lessons to be learned.

Once a boy starts out with the idea that tools can be used carelessly, the habit is soon acquired and usually becomes permanent. The reverse is equally true. If you give your pupils to understand that in your shop there is "a place for everything and everything in its place," the habit of care and orderliness will become a fixed practice.

It does not matter how well made a tool may be, if it is not kept in good condition it cannot do the work that it is intended to do. This is especially true of saws, chisels, and planes.

One of the most common abuses of tools is to have them piled together on top of the bench—teeth of saws up against jack planes, lumber and tools laying on saw blades, planes setting face down on bench, chisels with bevelled edge up, etc.

Another thing that requires constant checking is the manner in which some pupils throw their tools around after using them. The saw is a frequent sufferer from this kind of carelessness.

Another practice that often damages tools is the keeping of too much material on the top of the bench. This is frequently the cause of tools falling from the bench to the floor.

There should be a definite place on every bench for each individual tool and likewise there must be a certain place for every tool that goes into the tool room.

No one, however experienced, can do good work with dull tools.

For this reason a boy should be taught early how to sharpen plane irons and chisels, and might to advantage be given practice in sharpening saws. (Disston sells at a nominal price what are known as Practice Filing Pieces, about 2½ x 6 inches, which may be used for this purpose.)

Fig. 6.—Tools improperly arranged on bench.

The following rules regarding the keeping of tools in good condition may be printed and posted in a prominent place in the shop, or a mimeographed copy may be furnished each pupil:

General Rules for Keeping Tools in Good Condition

1. Always remember that the good craftsman keeps his tools in good condition at all times.
2. Keep the top of your bench as clear and clean as possible.
3. Always lay your plane down on its side so as to protect the cutting edge of the iron.
4. Be careful to place the tools on your bench with the cutting edges away from you.
5. Whenever a tool shows signs of dullness, sharpen it at once.

6. Keep the teeth of your saw away from other tools, do not jam the point against other objects when sawing; do not force the saw if it binds in an uneven cut; do not use your saw to pry off part of the wood when making a cut.
7. Remember you are more likely to cut yourself with a dull tool than with a sharp one.
8. The sharper you keep your tools, the more pleasure you will get in using them, and the better will be your work.
9. Immediately eliminate the slightest sign of rust by using a piece of fine emery cloth and kerosene. Rust may be prevented by the use of vaseline or a good oil.
10. When you are through with a tool lay it down carefully; do not drop or throw it down.
11. When you are finished with your work for the day carefully place all tools in their assigned places and return any tools borrowed from the tool room.
12. Never forget that if you take pride in the upkeep of your tools you will be proud of the work you turn out with them.

Section B

Regarding the Use of Machinery

Care of Machinery

Success with shop machinery depends to a considerable degree on proper installation and maintenance.

Careful attention to the following details will go far in keeping your machinery 100 per cent. efficient:

1. Make sure that you have a good foundation on which to place your machine. In many cases the floor of school shops is not planned to take care of heavy machinery.
2. See that your machine sets perfectly level. This is very important and will well repay any time devoted to it.
3. By all means have a switch mounted on the machine, so that the power may be easily shut off in case of emergency.
4. Be careful to enclose all belts, pulleys, and gears, and see that all saws, knives, etc., are properly protected with safety devices.

5. Make sure that you use the right kind of oil for lubricating purposes. It should be neither too heavy nor too light. If you are not sure as to the best kind of oil to use, obtain the advice of someone who is accustomed to running machinery.
6. Never let the bearings or running parts of any kind of machinery run dry—this is a common fault with inexperienced or careless operators.
7. All machinery should be periodically and thoroughly overhauled. This will not only be the means of getting better service, but will also add considerably to the life of the machine.
8. Before running lumber through a saw or planer, make sure that it contains no nails or grit.
9. When machinery is first installed it is best to run it for a few hours without any load. This permits a gradual adjustment of the running parts. During this period watch carefully for any signs of excessive heating.

Avoidance of Machinery Accidents

The large majority of accidents can be directly traced to carelessness.

It is now generally conceded that high school boys, under proper instruction, are capable of running ordinary woodworking machinery. Sometimes boys in elementary schools are allowed to use machinery while under observation of an instructor.

This latter practice should be confined to eighth grade boys. It needs to be very carefully supervised and should never be attempted with large classes, as the element of danger is too great.

Fortunately, accidents in school shops have been very infrequent. Care and proper organization will still further reduce them.

The following procedure is suggested as a means of doing all that is humanly possible to avoid accidents:

Assume that you have a class of high school boys or a group of boys in a vocational school, whom you intend to give permission to use machinery. First, call them all together and give them a straight-from-the-shoulder talk. Make it clear to them, for instance, that a band saw will cut fingers as well as wood. Be careful, however, not to make them fearful of the machinery, but at the same time tell them enough as to its danger to insure cautiousness.

After having done this, take them in groups to the various machines and explain everything thoroughly and go over the various operations.

Then let each boy do some piece of work on the machine while you watch for mistakes and any apparent carelessness.

Those who pass the test satisfactorily should be given a card (see below) and also a set of rules governing the use of the machines (page 35).

While this looks like a somewhat lengthy procedure, as a matter of fact, it does not take long if properly organized. If these precautions are the means of saving the fingers of one boy who otherwise might have lost them, your thoughtfulness will have been worth while.

A prominent instructor tells of an accident that occurred in his first year of teaching, when a certain school board had some woodworking machinery installed. It was about ready for use when a member of the board looked it over and then gave orders that no one in the school should be allowed to use it except the instructor. A week later one of the boys left school to go to work. He had only been working three days when he had the tops of three of his fingers cut off by a band saw.

Had he been accustomed to using machinery under the right kind of direction, the possibility is that the accident would not have happened.

MANUAL ARTS DEPARTMENT

This is to certify that ______________________________
has passed an examination in the use of the machines checked below and is permitted to operate them at his own risk.

Pupils will not be allowed to use the shop machinery unless they possess one of these cards, duly signed by the instructor and supervisor of the department.

Neglect to follow rules pertaining to the operation of the machinery will result in this card being withdrawn.

Instructor ______________________________

Supervisor ______________________________

Circular Saw	Band Saw	Planer	Grinder	Lathes	Mortiser

Fig. 7.—Card used by instructors in one large city. Cards are given to boys who qualify to operate machines. Cards are withdrawn promptly for any carelessness or failure to use machine as instructed.

RULES PERTAINING TO THE USE OF MACHINERY

(To be posted in a permanent place near machines and used in connection with card shown in Figure 7, page 34.)

No pupil is allowed to use any machine in this shop until he has obtained a signed card from the instructor.

Failure to observe the following rules will result in the card being withdrawn and the privilege of using the machinery taken away:

1. Whenever possible, work with your sleeves rolled up. Do not operate machines while wearing a loose necktie, torn sleeves, or a torn jumper.
2. See that machine is clear of pieces of lumber, tools, etc., before throwing in the switch.
3. If the machine does not operate in the way you think it should, or if anything goes wrong, immediately shut off the power and report to the instructor.
4. Always bear in mind that carelessness leads to accidents. Go at your work carefully and thoughtfully, giving it your undivided attention.
5. Never speak to another person while he is actually using a machine. A moment's detraction may lead to an accident.
6. It is dangerous to do operations on a small piece of wood on the circular saw or jointer. If occasion arises when you have to run small pieces, use a "push stick." Never use your fingers when running small work through.
7. Make sure that there are no nails or grit in the lumber you are using.
8. Always use the safety devices that are on the machine.

CHAPTER III

Hand Saws

Section A

How a Saw Cuts

IN ANY consideration of what actually happens when a saw severs a piece of wood, two different kinds of cutting must be recognized. Saws are divided, so far as their functions are concerned, into Cross-cut Saws and Rip Saws. The Cross-cut Saw cuts along a line that crosses the grain or fibers of the wood. The Rip Saw cuts on a line which follows the same direction as the fibers. (See Figs. 8 and 9.)

Fig. 8.—Side view of cross-cut teeth.

End view.

The mechanics of the cutting action of these two types of saws are radically different, as will be seen later.

The actions of both the knife and the chisel are employed in the cutting done by a cross-cut saw. A cross-cut saw removes successive pieces of material, not shavings, but small particles called sawdust, by scoring, cutting, and paring.

Take a cross-cutting hand saw, properly set and sharpened, each tooth of uniform size, shape, set, and bevel. Make with this a light short cut across a smooth piece of lumber. One can see that the extreme points on

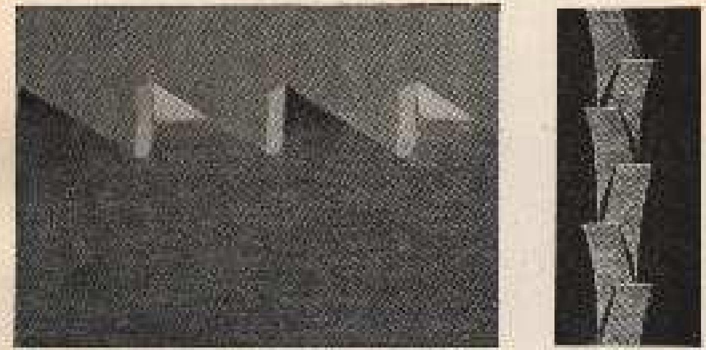


Fig. 9.—Side view of rip teeth. End view.

both sides of the cutting width of the saw first made parallel scorings the width of the set. (See Fig. 10.)

These scorings are similar to the fine cutting of a knife across the face of the wood, thus starting the cut. Then, as pressure is applied, the teeth enter deeper and deeper, gradually bringing into action the cutting edge on

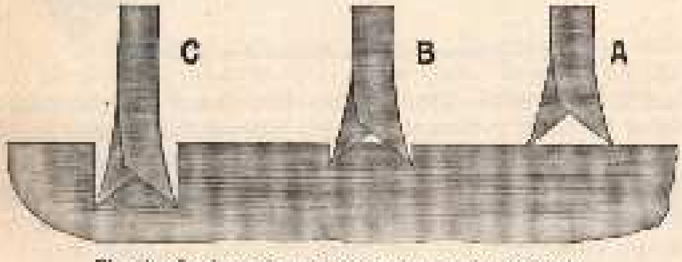


Fig. 10.—Scoring and cutting of cross-cut teeth (end view).

the outside front of the points. The forward motion of the blade causes the points and cutting edges to strike the fiber at a right angle to its length, scoring it from the main body of wood on each side of the blade, and paring the ridge of wood between scorings. (See Fig. 11.)

A continuation of the thrust pressure carries the teeth in farther until the full bite is taken. With the points scoring continuously on each stroke and the outside edge of the tooth cutting, the outside front edge of each

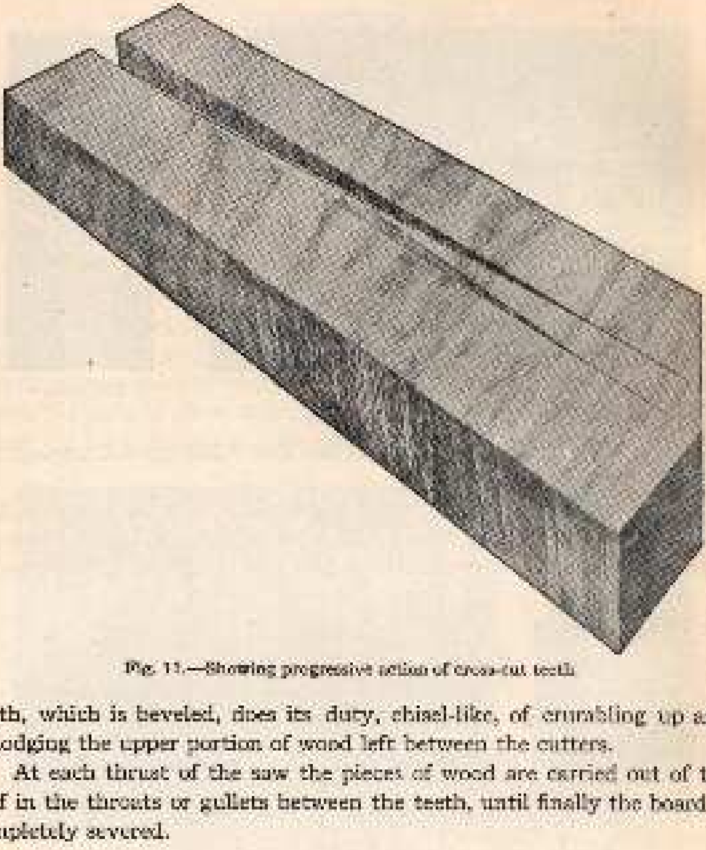


Fig. 11.—Showing progressive action of cross-cut teeth

tooth, which is beveled, does its duty, chisel-like, of crumbling up and dislodging the upper portion of wood left between the cutters.

At each thrust of the saw the pieces of wood are carried out of the kerf in the throats or gullets between the teeth, until finally the board is completely severed.

Sawing in the Direction of the Grain

The nearest approach to the cutting action of a Rip Saw is the action of a chisel cutting with the grain. The chisel separates and removes a wood shaving by what may be appropriately termed "paring" or "slitting." Its relatively broad, sharp edge severs the fibers of wood lengthwise with the grain, and tears them loose at the sides as the chisel advances, as shown in Fig. 12.

The teeth of a Rip Saw are practically a series of small chisels. They are different in design and shape from the teeth of a Cross-cut Saw.

It is possible to use a Cross-cut Saw for ripping, although such a use is far from efficient. It is almost useless to attempt to use a Rip Saw for cross-cutting.

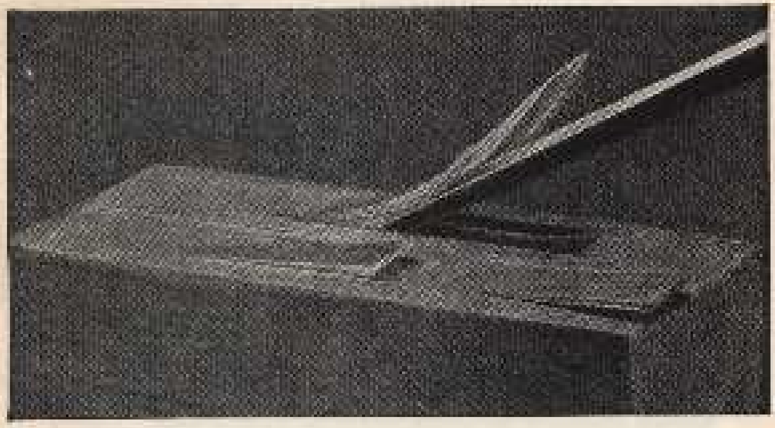


Fig. 12.—Comparing action of rip saw teeth with a chisel.

The Rip Saw tooth has a straight front. Its cutting edge strikes at practically a right angle to the fiber of the wood. It severs the fibers at one place only, the front of the tooth wedging out the little pieces as it separates them. (See Fig. 13.)

This may be more clearly understood by making a direct comparison with the cross-cutting tooth. As previously stated, the cross-cut tooth scores with the point and cuts with the knife edge on the outside front.

The rip tooth, on the other hand, does not score either side of the cut. The front edge of the rip tooth cuts the fibers of the wood, and then, as continued pressure is applied, the fibers on the bottom and the sides give away and the piece, as sawdust, is carried out of the cut in the gullets between the teeth. In this way one tooth after the other chisels out small sections of wood, first on one side of the kerf and then on the other, until the cut is completed.

It will be noticed, glancing down the tooth-edge of a saw for cross-cutting, that the pointed teeth, set alternately to right and left, leave a shallow groove which runs down the center of the cutting edge from butt to point.

This is not true with a rip saw where the square-topped teeth are set so that the outer edges extend beyond the side of the blade to give clearance while the inner edges overlap slightly at the center of the cutting edge. (See Figs. 8 and 9.)

It is a common supposition that the entire tooth of a saw cuts. As a matter of fact, however, the actual cutting is done, with the cross-cut saw,

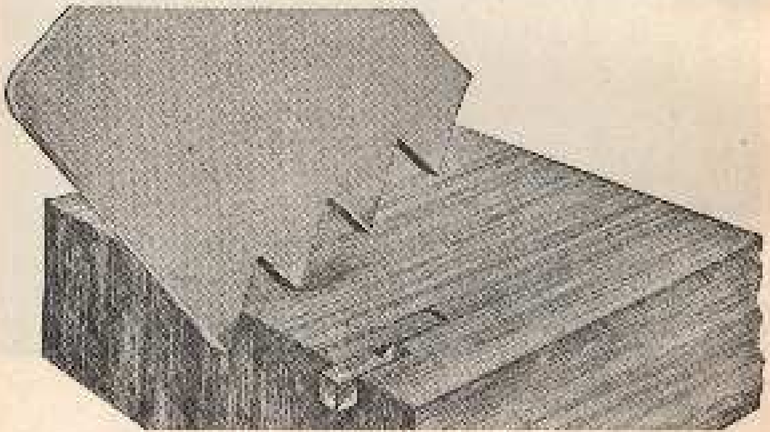


Fig. 10.—Action of rip saw teeth.

by the points and front cutting edges, which extend only to where the right and left teeth overlap; and, with the rip saw, by the chisel-like edge of the teeth.

Because they are set alternately right and left, each tooth individually severs only half the width of the kerf. This division of duty by the numerous teeth in the hand saw makes possible the performance of quicker work, involving less effort and driving power.

So it will be seen that, with a rip saw, the cutting edge of each tooth makes an incision across the long wood fiber. Then the base of the tooth plows out the small pieces thus separated. This is done continuously with each stroke of the saw. The saw enters farther with each thrust, the kerf becomes deeper, until a complete separation of the board is accomplished.

Section B

How to Use a Hand Saw

Saw specialists have devoted a great deal of thought and time to the matter of hand saw practice.

The saw is a unique tool in many respects. It performs its functions by a method that is different from that of any other tool.

Because of this, and because proper use is necessary to get good work from a saw, a short discussion of the theory of sawing seems desirable.

Grasping.—Consider first that the handle of a saw is a much more important part than is the case with most tools.

The power of arm and shoulder is delivered to the saw through the handle; and accuracy, speed, and production in sawing all depend very largely on its design and location.

The Disston handle is an inset handle. It is built onto the blade of the saw, the metal being shaped to receive it. It is made to fit the hand.

Study the hand a moment. A line joining the bases of the fingers makes a curve almost as regular as the arc of a circle, with the center of this arc in the fleshy mound at the base of the thumb.

Now grasp the handle, and observe how the concave shape of the handle where the fingers close around it produces a "squeeze" that braces the fingers more firmly against each other. This throws the main duty of grasping the handle on to the three last fingers of the hand. As a matter of fact, it makes it both easy and logical to use the thumb and first finger for guiding rather than grasping.

This theory is more readily understood when the saw is put into a cut. It will then be apparent that the point at which the power is applied is across the center of the hand opposite the three last fingers. The curve of the handle helps to maintain the thrust at this point, and the saw runs just as easily and readily if the thumb and first finger are not used for grasping at all after the cut has been started. The lower horn of the handle is useful, as will be noted, to hold the hand compactly and prevent it from spreading.

It is quite possible, in view of the above considerations, to use both the thumb and first finger to guide the saw.

It is essential for good sawing that the saw run in a straight line with the forearm, so that it is practically a continuation of the arm. It is important, too, that the user stand in such position that his elbow and shoulder are in direct line with the saw as in Fig. 14.

The operator usually works with two limiting factors: he must cut along a straight surface line, and he must cut vertically to the surface on which that line is drawn. These results are obtained much more readily when the saw is held as described above.

Fig. 14.—Proper position for arm, hand, and saw for cross-cutting.

Hold your saw with the thumb and forefinger lying extended along the sides of the handle. This helps you "point" the saw along the line. You will find this grip to be easy to acquire, even if you have used another method for years. Students and apprentices learn accuracy with this grip more surely and quickly than with any other.

The handle should be grasped firmly, but not squeezed too tightly. A great deal of fatigue is caused by gripping the handle more tightly than is necessary.

The upper horn of the handle functions on the back stroke, when it prevents the hand from sliding up as the saw is drawn back.

The method of grasping just described is regarded as best for accuracy. Disston handles are of such a design, however, that the thumb and all four fingers can be used to grasp the handle if working conditions or personal preference suggest.

Position.—In considering the most efficient position in sawing, another factor must be dealt with. The eye must be brought into the same

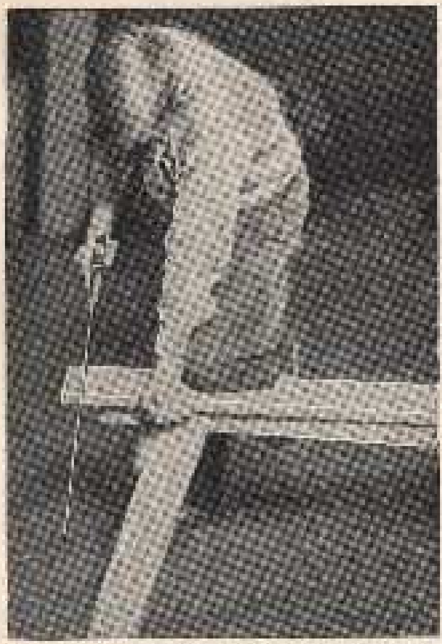


Fig. 15.—Front view of correct cross-cutting position. Note straight line of action.

plane as blade, elbow and shoulder, so that the line of vision is true with the cutting plane. (See Fig. 15.)

The eye follows the progress along the square edge, and the position taken must permit of this. The work may be held or steadied by the left hand. Often, when the work is on a sawhorse, the knee is used also.

Left-handed pupils should learn to adapt these instructions to the left side of the body. We believe that it causes complexity and delays progress for left-handed pupils to be forced to learn right-handed sawing. However, it frequently happens that persons who regard themselves as left handed are actually ambidextrous. A little experimenting will clear this question up in any given case.

Holding the Work.—Good judgment will provide an answer to most questions regarding holding the work for sawing.

When it is of a shape and size that permits, it is often convenient to hold the work in a vise or on a bench hook.

Fig. 16.—Supporting waste to insure clean cut-off.

Sawhorses are usually knee-high or slightly higher, since the knee is commonly used to help hold the work on them.

In rip sawing, and when the waste piece is heavy in cross-cutting, the work is likely to split off as the cut nears completion, unless properly supported. (See Fig. 16.).

The left hand is used to support short waste pieces as the cut nears its end. Mechanical support is necessary when the waste is heavy.

A little experience soon teaches the pupil to properly stabilize his work before he starts his cut.

Starting the Cut.—The line has been drawn. The pupil has assumed an easy sawing position with the work properly supported.

The middle of the blade edge rests against the far edge of the board to be cut.

Do not attempt to split the scribed or penciled line. Start the cut close to the line, on the waste side. Grasp the edge of the board with the left hand, close to the line, so close that either the knuckle or the end of the thumb will bear against the saw blade and support it vertically. (See Fig. 17.)

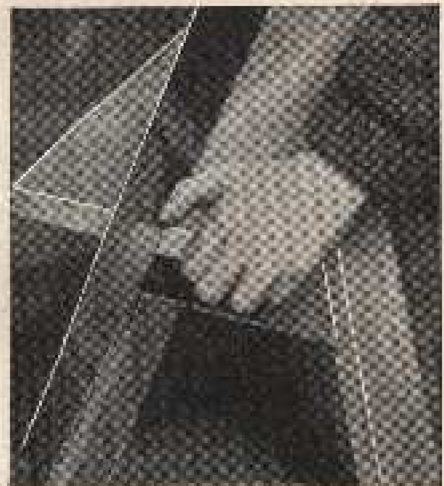


Fig. 17.—Supporting blade with thumb to start cut.

Raise the thumb sufficiently to prevent its being cut by the saw teeth. Sawing is begun by drawing the blade slowly toward the operator two or three times so as to start a kerf or cut in which the blade will run smoothly. If the first strokes are away from the body the saw will jump to the right or left or split out the wood. Experience teaches that the scoring to start the cut should be done with a draw stroke (pulling toward user).

Finishing the Cut.—After the groove has been started, a few short forward strokes will deepen the cut so that the left hand may be moved away free of the blade.

The saw should then be pushed with an easy, free-running motion, making the strokes approximate the full length of the blade, so that each tooth may do a fair share of the work. Short strokes dull the saw more rapidly for the reason that a few teeth do all the cutting.

Impress on your pupils the fact that the cutting angle and the spacing of the teeth control the amount of cutting done by one stroke of the saw. The correct angle for the saw in cross-cutting is about 45 degrees from the horizontal, while in ripping the saw is held more nearly erect, at about 60 degrees. It is unnecessary and tiring to bear down or "ride" the saw. Downward pressure through the wrist is wasted effort. If the saw does not "feed" itself under normal pressure, it is probably out of condition.

Do not try to force the saw if it jams in the cut. When this happens, something needs correcting. Either the wrong saw is being used or the saw is not in proper condition. Stop and find the trouble.

In cutting off the end of a board inexperienced saw users sometimes attempt to remove the waste wood by twisting the saw-blade in the cut. This may permanently crimp the blade, destroy its tension, and render it unfit for use.

The ability to make a smooth vertical cut along a given line is a result of practice in the correct position. Do not permit pupils to try to run the saw at an abnormally flat angle in an effort to follow the line. This will not gain the desired results, for the theory is incorrect, as will be seen by reference to "How a Saw Cuts," elsewhere in this book.

Speed and skill with the hand saw are developments that grow only out of careful practice of the right fundamentals, such as proper grasp, correct, easy position, starting and completing the cut properly.

Above all, of course, it is necessary that the saw itself be properly made, set, and sharpened—for even the most expert workman must have a good saw to do good work.

Section C

How to Set and Sharpen a Hand Saw

FOLLOW THESE DIRECTIONS. Before starting work, read ALL the directions. Then, as you work, read them step by step.

Examine the tooth-edge of your saw carefully to see if the teeth are uniform in size and shape.

If the teeth are uneven, it is necessary to "joint the saw" and "shape the teeth" in accordance with instructions on pages 47 and 48. However, if the teeth are of uniform size and correct shape, as shown in Figs. 18

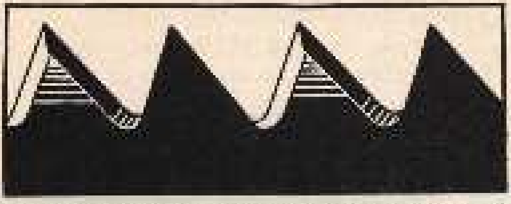


Fig. 18.—Teeth of cross-cut saw (magnified) showing correct shape.

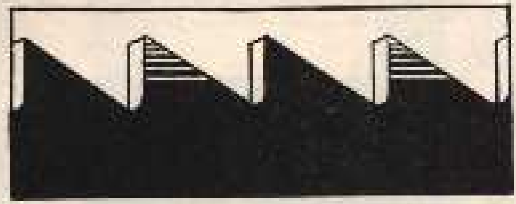


Fig. 19.—Teeth of rip saw (magnified) showing correct shape.

and 19, "Jointing" and "Shaping the Teeth" are not necessary and you should start with the chapter on "Setting" on page 48.

Jointing

To be done only when the teeth are uneven or incorrectly shaped, as explained before.

Place the saw in a clamp, handle to the right. Lay a mill file lengthwise on the teeth. (If available, use a hand saw jointer for more accurate work.) Pass it lightly back and forth the length of the blade, on the tops of the teeth, until the file touches the top of every tooth.

Fig. 20.—If the teeth of your saw are as uneven as this, it probably needs to go back to the maker to be put into good condition.

If the teeth of your saw are very uneven, it is best not to make all the teeth the same height the first time they are "Jointed." In this case "Joint" only the highest teeth first, then "Shape" (see "Shaping the Teeth," page 48) the teeth that have been "Jointed," then "Joint" the teeth a second time, passing the file along the tops of all the teeth until it touches every tooth. The teeth then will be of equal height. Hold file perfectly level. Do not allow it to tip to one side or the other.

Fig. 21.—This saw needs Jointing.

Fig. 22.—The saw in Fig. 21 after Jointing. Shape the teeth next.

The Disston Hand Saw Jointer holds the file correctly and does this work quickly.

Shaping the Teeth

To be done only when the saw has been "Jointed." After "Jointing," all teeth must be filed to the correct shape. The gullets must be of equal depth. The fronts and backs of the teeth must have the proper shape. (See Figs. 18 and 19 for shape. Disregard bevel.)

To do this, place the file well down in the gullet and file straight across the saw, at right angles to the blade (under no conditions hold the file at any other angle). If the teeth you are filing are of unequal size, press the file against the teeth having the largest tops, until you reach the center of the flat top made by "Jointing."

Then move the file to the next gullet, and file until the rest of the top disappears and the tooth has been brought up to a point. Make no effort to bevel the teeth at this time.

Setting

You need not reset the teeth of a well-tempered hand saw every time the teeth need a light sharpening. If it was not necessary to "Joint" and "Shape the Teeth," examine the saw to see if the teeth have the proper amount of set indicated in Figs. 23 and 24. If they do, the saw is ready for filing. If they do not, set them in accordance with the following instructions.

Note: It always is necessary to set the teeth when you have "Jointed" and "Shaped the Teeth" of your saw.

Fig. 23.—Looking down on the tooth-edge (magnified) of a cross-cut saw properly set.

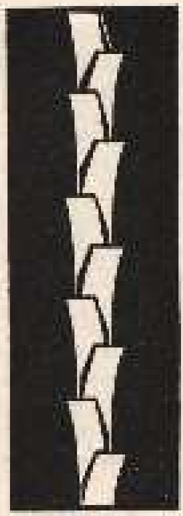


Fig. 24.—Looking down on the tooth-edge (magnified) of a rip saw properly set.

"Setting" is springing over the upper part of each tooth, one to the right, the next to the left, to make them cut a kerf slightly wider than the thickness of the blade, to give clearance. (Figs. 23 and 24.) The same method is used for both cross-cut and rip saws.

The main thing is to avoid springing the teeth more than is necessary (just enough to cut a kerf slightly wider than the thickness of the blade) and to spring no more of the tooth than the half nearest the point.

A well-made saw needs very little additional clearance. If more than the upper half of the tooth is set, it may crimp the blade, even if the tooth itself does not break.

Setting with Hammer and Anvil.—This method requires a great deal of skill and practice. It is not recommended to any but the most skilful mechanics.

Setting with Saw-set.—The best method for all but experts is to use what is known as a "Saw-set." This is a special tool which sets the teeth by pressure. Disston makes a saw-set which does this work properly. It is called the Disston Triumph Saw-set. Complete instructions come with it.

Filing

A Disston Taper File (three-cornered) should be used, its size varying with the fineness of the teeth. The table below indicates the particular style of file to be used on the different point rip and cross-cut teeth:

5 and 5½ pt. Cross-cut	6" reg. taper file.
6, 7, 8 and 9 pt. Cross-cut	4½" reg. taper file.
10 and 11 pt. Cross-cut	5½" slim taper file.
4½, 5, 5½ and 6 pt. Rip	4½" reg. taper file.
4 pt. Rip and coarser, 6" regular taper file.	

(To determine the "point" of a saw, count the number of tooth points to the inch, measuring one inch from the point of any tooth. Note that there is always one more point to the inch than there are complete teeth to the inch. See Fig. 27.)

Fig. 25.—First position for filing cross-cut saw.

Place the saw in filing clamp with handle at right. The bottom of the gullets should be ⅛" above the jaws of the clamp. If more of the blade projects the file will "chatter" or "screech." This dulls the file quickly.

It will assist you to file a saw properly if, at the start, you pass a file lightly down the tops of the teeth (just as instructed under "Jointing" on page 47) to form a very small flat top on each tooth. The purpose of this is to provide a guide for filing. It does, however, again even up the teeth, which was the main purpose of "Jointing." Now, file the teeth as instructed in the following paragraphs.

Filing Cross-cut Saws.—Stand at First Position, Fig. 25. Start at the point. Pick out the first tooth that is set toward you. Place file in the gullet to the left of this tooth. Hold file directly across the blade. Then swing the file handle toward the left for about 45 degrees (half of a right angle). Correct angle is shown in Fig. 25.

Hold the file level and at angle shown. Do not allow it to tip upward or downward. Be sure the file sets down well into the gullet. Let it find its own bearing against the teeth it touches.

The file should cut on the push stroke. It files the tooth to the left and the tooth to the right at the same time. File the teeth until you cut away one-half of the flat tops you made on the teeth as a guide, then lift the file from the gullet. Skip the next gullet to the right, and place the file in the second gullet toward the handle. Repeat the filing operation on the two teeth the file now touches, being careful to file at the same angle as before. Continue this way, placing the file in every second gullet, till you reach the handle-end of the saw.

Fig. 26.—Second position for filing cross-cut saw.

Study Fig. 26 before you go further. Turn the saw around in the clamp, handle to the left. Take Second Position. Place the file in the gullet to the right of the first tooth set toward you. (This is the first of the gullets you skipped when filing the other side of the saw.) Turn file handle 45 degrees toward right this time. Now file until you cut away the other half of the flat top made on the teeth as a guide, and the teeth are sharpened to a point. Continue this, placing file in every second gullet, till you reach the handle of the saw.

Filing Rip Saws.—With one exception, the method is exactly the same as that given above for Cross-cut Saws.

This exception is that rip saws are filed with the file held straight across the saw, at a right angle to the blade. Some mechanics, however, prefer to file a slight bevel in rip saws.

Place saw in clamp with handle toward the right. Start at the point. Place the file in the gullet to the left of the first tooth set toward you.

Continue placing file in every second gullet and filing straight across. When handle of saw is reached in this way, turn saw around in the clamp. Start at point again, placing file in first gullet skipped when filing from other side. Continue again in every second gullet till handle-end of saw is reached.

Section D

How to Order a Hand Saw

The following information should be given when ordering hand saws:

1. Specify rip or cross-cut saw.
2. Number of points to the inch.
3. Length of saw.
4. Manufacturer's number or style, as "Disston D-8."

Figure 27 shows the respective number of teeth and points per inch which they represent.

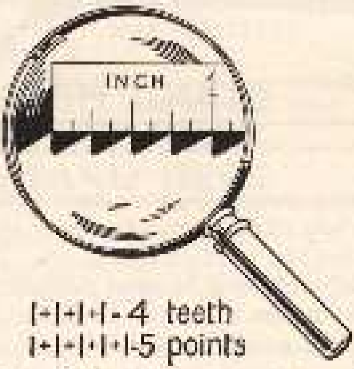


Fig. 27.—Method of determining points per inch.

It will be noticed that in one inch space there is one full tooth less than there are points.

The Difference Between Cross-cut and Rip Saws.—Hand saws are divided into two main classes—cross-cut saws for cutting across the grain, and rip saws for ripping or cutting with the grain.

The difference between these two classes of hand saws is in the shape of the teeth—one being designed to cut across the grain with an action similar to a number of small knife blades, and the other for ripping apart when cutting parallel to the grain with an action like that of many chisels. (See chapter on "How a Saw Cuts.")

Determining the Point of Saw Best Suited to Your Requirements.—A saw with a few tooth points to the inch (say 6 or 7) will cut fast and make a comparatively rough or coarse cut. These points are commonly used for ordinary construction work and similar rough sawing.

The saws with many tooth points to the inch (10 or 11) will make smooth, even cuts, and are used mostly for interior finishing, furniture making, etc.

Most of the lumber used in school shops is dry and well seasoned and, therefore, a fine tooth point saw can be used to advantage. Green, wet wood requires a coarser saw (few points to the inch).

Hand Saws for cross-cutting are made in sizes ranging from 5 to 11 tooth points to the inch. Hand Saws for ripping are made from 4½ to 7 points to the inch.

The saws most commonly specified for students' use are 22 to 24 inches in length, 9 points to the inch for cross-cutting and either 6 or 7 points to the inch for ripping.

Length of Saw to Be Used.—The length of a rip or cross-cut hand saw is always measured by the length of the cutting edge. For instance, a 26" saw means a saw measuring 26" long on the cutting edge of the blade.

The terms "cross-cut" and "rip" refer to the shape and style of the teeth only and not to the length of the saw or size of teeth.

Meaning of "Skew-back" and "Straight-back."—The expressions "Skew-back" and "Straight-back" refer entirely to the shape of the back of the blades. The skew-back blade is cut on a curved line at the back. The straight-back blade, as the name implies, is cut on a straight line from butt to point. The choice of one over the other is entirely a matter of personal preference. The skew-back blade is slightly lighter in weight. A straight-back gives the blade more "body" or stiffness. For this reason men who use an especially heavy thrust pressure sometimes prefer the straight-back saw. There are also what are known as "Ship Pattern" hand saws. These are exactly like regular hand saws excepting that the blade is not as wide and, therefore, the saws are slightly lighter in weight. For any further information see pages 150 to 156.

Section E

Special Purpose Saws and Their Uses

Under the head of reciprocating saws we find a long line of small saws for various purposes.

Among them are the several forms and sizes of back saws, some of which are shown on pages 156 to 159.

This type is used for very fine cutting or where a perfectly straight and even saw cut is required. The blade is thin and the saw has a back of steel or brass to hold the blade rigid and true. This type of saw is also made with a movable steel back which can be adjusted to make any depth of cut required for tenoning, dadoing, and dovetailing. (See Fig. 127.)

The larger back saws, 20 inches or longer, are commonly known as mitre-box saws. The special shape of the butt or heel in these saws prevents its catching in the work when used in a mitre-box.

The Compass Saw is a useful little tool, having a fine, tapering blade. This saw is used principally for cutting circles and curved work where it is first necessary to make a hole with a center-bit. The student, when using this type of saw, should be cautioned to use the saw carefully so that it will not bind in the cut and, perhaps, buckle the blade. It is suggested that instructors demonstrate the use of compass saws before giving them to students.

Another form of compass saw is one with an adjustable handle. (See Fig. 138.) The handle of this saw is made so that different blades may be substituted easily.

Somewhat similar to a Compass Saw is a small saw called the Keyhole Saw. In addition to the regular Keyhole Saw there is an adjustable type which has a handle with a socket large enough to receive the saw blade. The blade, which is adjustable to any length, is held in position for use by the tightening of a thumb-screw, as shown in Fig. 134.

Sometimes these saws are made so that one end of the blade can be used as a screw-driver, which is brought into position by simply loosening the thumb-screw, pushing blade through the handle, and tightening screw again.

Another small-sized saw is called a Dovetail Saw, illustrated in Figs. 131, 132, and 133. It is used for cutting dovetails and doing other small and delicate work. Wood cut with this saw may be glued without planing. The dovetail saw is used by cabinet makers and pattern makers. It is included in most school shop equipment.

The next type of reciprocating saw is the "tension" or "web" type, see Fig. 140. These saws have a thin narrow blade strained in a frame of wood or metal.

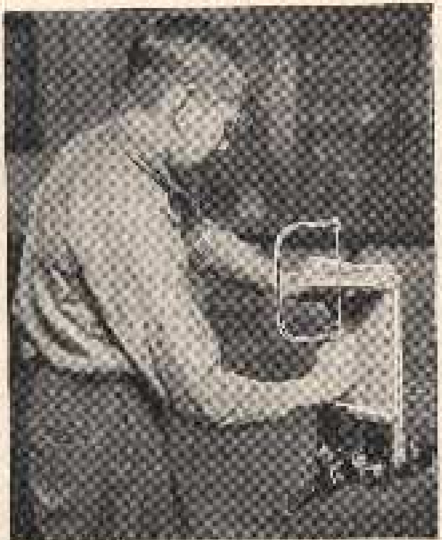


Fig. 28.—Proper use of coping saw with saddle.

The oldest and most generally known form of this kind of saw is the Buck or Wood Saw.

A type of saw widely used and practically indispensable for metal cutting is the Hack Saw. Figures 141, 142, and 143 illustrate some of the most used types. A type very convenient in school is shown in Fig. 143 (low frame). Hack Saw blades ordinarily are narrow in width, and from 6 to 12 inches in length; some are hardened throughout, and others, for use where the danger of breakage is great, are hardened on tooth-edge, with a flexible or "soft" back. The Disston "Chromol" is an all-hard blade and the Disston "Duraflex" is a flexible blade.

A Coping Saw consists of a rigid steel frame holding a narrow blade under tension. This tool is widely used in school shops. It seems well to describe its use in considerable detail.

If Coping Saw work is done on the thrust cut it can be held upright in the bench vise and the saw operated as is any other saw, following the line on the waste side. This is difficult and also cutting on the draw stroke with the work in this position is awkward. For this reason most instructors teach the use of the saddle, a rest provided with a V notch and attached to the bench so as to establish a horizontal frame on which the work can be held with the left hand while the coping frame held in the right hand is operated on the downward vertical stroke. This saddle can be made of ½- or ¾-inch stock, 4 by 8 inches, the triangle of the V being 3½ inches deep with 3-inch base. It can be clamped so as to project from any edge of the bench. To get the work up to a better height, it can be screwed on the end of an upright with a supporting bracket, as shown in Fig. 28.

For scrolling, as in toy work, fret work, inlays, furniture overlays, or moulding fitting, the figured board is held on the saddle and the coping saw is made to cut on the down stroke, the work being shifted and the saw swung to accommodate the curves as they are encountered. Teach the pupil not to try to halve the line, but to saw so that a hair width of white line shows beyond the pencil or scribing outline. Get as long a stroke as possible and avoid overheating the blade by very rapid motion across a narrow section of the blade. Keep the saw moving in the same general up-and-down axis to get more accurate work, using the jig saw as a model. If the blade enters so far that the back of the blade is in contact with the edge of the work, it is possible to turn the blade at right angles, and in many cases overcome this obstacle. If a blade is broken, make the pupil return the broken blade to you, in order that you may see and explain any misuse which has caused the breakage.

CHAPTER IV

Band Saws

Section A

General Information

A BAND saw, as illustrated in Fig. 29, is a continuous toothed band or belt of flat steel, stretched so as to run over two aligned wheels or pulleys.

These wheels are placed in a frame in "tandem," which means that one is above the other. The lower pulley drives the saw over the upper one. The upper pulley acts as an idler and permits the band saw to move as a belt does.

In order that the cutting edge may be brought against the material to be cut, the downward strand of the revolving blade passes through a flat table. The work is rested on the table and fed against the saw. Between the wheels and the table are guides which support the blade in position during the sawing operation. The guides prevent the saw from twisting or being pushed off the wheels.

Band saws ranging from 1/4" to 1 1/2" are commonly called "narrow." Narrow band saws are extensively used in woodworking shops, such as toy and furniture factories, pattern and cabinet making shops, cooperage and body building plants. Narrow saws permit cutting out curved and irregular shapes in making patterns, chairs, felloes of wheels, ornamental shapes for furniture, or interior finish. School shops use the "narrow" type of band saws exclusively.

The old-time band saws gave a much greater output than the "up-and-down" gang saw mills and the circular mills which they replaced. But they were small and crude and limited in their work. However, even at that time, they possessed an important feature that made them popular with mill men. This feature was thinness—which meant a smaller kerf and more boards from a log than was possible with any other type of saw.

When you consider that the modern band saw is extraordinarily thin in comparison with its width, that it is bent into a half-circle twice in every complete revolution, and, in addition, that it travels at the speed of

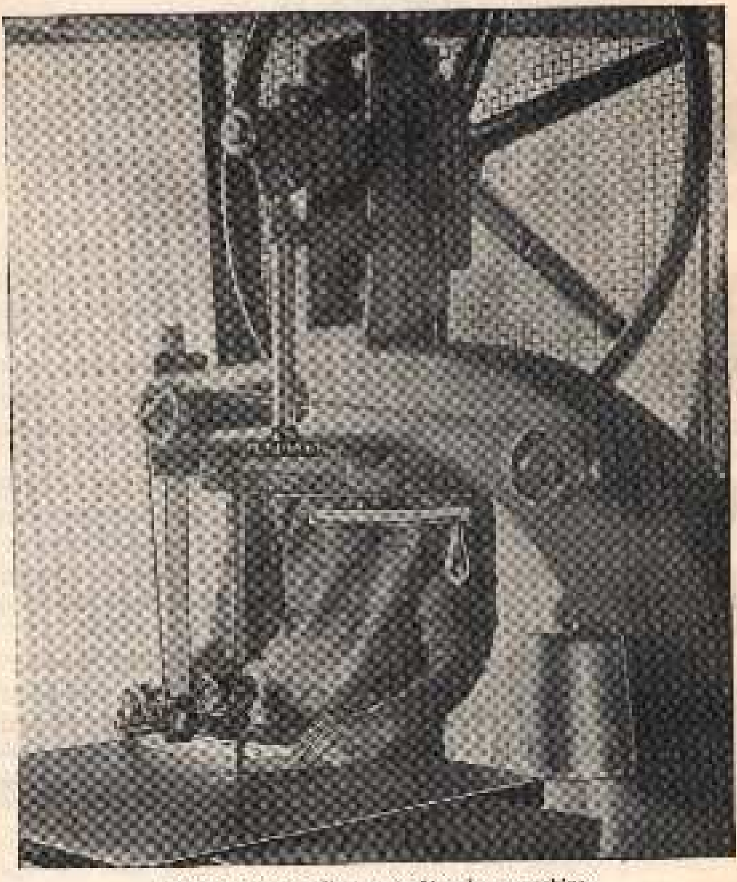


Fig. 20.—Proper adjustment of band saw machine.

the fastest express trains, you will have some idea of the strain to which it is subjected.

You will have, too, a conception of the wonderful quality of the steel that has made the production of these saws possible.

Section B

Band Saw Wheels

Band saw wheels were originally fitted with flanges to prevent the saw from running off the wheel, or from being forced off by the thrust of the cut. This practice was discontinued because the forcing of the blade against the back flange of wheel resulted in case-hardening it. This caused minute cracks in the back of the saw, and, as a result, the life of the blade was reduced by excessive breakage.

Guides were then introduced to prevent "backing off." In modern practice, however, use of guides has been modified, so that to keep the saw on the wheel is no longer one of their functions.

The saw wheels should run true and in alignment. The rim is usually covered with rubber. On narrow band saws the face of the wheel or track of the blade is perfectly flat. If the face of either wheel, especially of the lower wheel, has collected dirt or sawdust so as to be lumpy, this should be removed with sandpaper to eliminate the additional strain it causes on the blade. Practically all band saw machines are equipped with dust guards to prevent sawdust or wood getting between blade and wheel, but these are only partially effective.

The saw should be removed at intervals and the surfaces of the wheels examined and trued. If the diameter of the front edge of the wheel is reduced by wear, the normal strain on the cutting edge is lessened, and the back is strained. A saw will not cut straight and is more liable to develop cracks under such conditions. The saw also has a tendency to stretch along the cutting edge. If this is not compensated for by level and clean wheel surfaces it will cause dodging in the cut.

A saw blade is put under tension while it runs in one of several ways. One common way is with a spring under the journal of the upper wheel. Another is a pivoted lever with an adjustable weight. In the latter type the narrow bands are usually run at the middle setting of the lever arm. There should always be a certain amount of ready "give" to the blade when tested with the finger.

An experienced workman will test the correct tension by the stiffness of the blade near the surface of the table. The following gives the recommended tension for narrow band saws.

TABLE OF BAND SAW TENSIONS AND TESTS

Width of Blade, Inches......	⅛	¼	⅜	½	⅝	¾	⅞	1	1¼
Tension in Pounds..........	25	55	100	160	200	240	280	320	400

The bearing of the upper wheel is pivoted to permit its being swung in or out from the plane of the lower or driving wheel. The position of the blade on the wheel is changed by a slight movement of this upper bearing, the rule being that the saw runs to the low side of the tilted wheel. If the upper wheel is tilted away from the operator, the saw will run back on the upper wheel, or against the guide. In any arrangement the band will run on the lower wheel as directed by the upper.

Running the band saw with the wheel tilted too much tends to stretch the saw at the cutting edge and causes it to acquire a twist, so that it assumes a figure eight when removed from the machine. Little tilting is necessary to make the saw run on the center of the wheel. Too much makes it press against the guides, which is harmful and unnecessary. A slight quiver in running does not affect the smoothness of its cutting.

Loose wheel bearings should be corrected to prevent vibration of the wheel and consequent shock on the blade. This is a point that should not be overlooked. Loose bearings are often caused by saws that are too thick at the braze. These set up sufficient knock to loosen the wheel bearings. Wheels can be tested when the saw is removed to see if they run easily and true. Journals should be oiled regularly.

Section C

How to Order a Band Saw

Band saws should be selected in a width of blade suitable to as broad a range of work as possible. Obviously, if the saw is to be used for cutting curves of short radii, it must be narrower than if it is to saw on longer sweeps or straight lines.

Consider Fig. 30. This shows an enlarged cross-section of a band saw turning on a small radius. Observe that the blade is tangent to the curve not at the cutting point, but at A, the middle of the blade. Also, the thickness of the blade limits the clearance at B. Practically all blades from ⅛" to 1" are 21 gauge, or .032 inch thick. The set of all blades is proportional to the width of blade and size of tooth. For usual curves

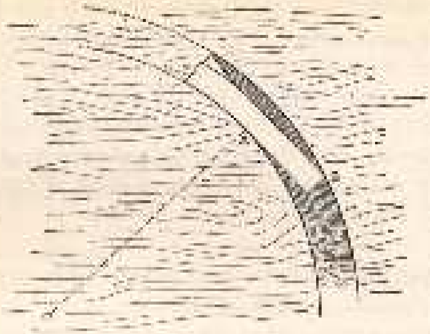


Fig. 30.—Section of band saw in curved cut.

the following table gives both a theoretical and recommended width of saw for radius of pattern to be cut:

TABLE OF RECOMMENDED BAND SAW WIDTHS FOR CUTTING CIRCLES OF SMALL RADII

Width of saw, inches	Standard Specifications			Minimum radius to be cut, inches
	Points to inch	Thickness		
		in inches	in gauges	
1/8	8	.028 or .025	22 or 23	3/8
3/16	7	.032 or .028	21 or 22	5/8
1/4	6	.032 or .028	21 or 22	7/8
3/8	5½	.032 or .028	21 or 22	1 3/8
1/2	5	.032 or .028	21 or 22	2 1/4
5/8	4½	.032 or .028	21 or 22	3
3/4	4	.035 or .032	20 or 21	4½
7/8	4	.035 or .032	20 or 21	6
1	3½	.035 or .032	20 or 21	8
1¼	3½	.042 or .035	19 or 20	12
1½	3	.042 or .035	19 or 20	20

In ordinary construction there are few exterior curves less than 1½" in radius or few interior curves less than ¾". The average school shop requires two ¼" or ⅜" saws for the curved work and two ½" or ¾" widths for ripping and cutting curves of larger sweep.

The alternate compression and tension to which inner and outer faces are subjected limits the thickness of band saws to the gauges regarded as standard. We recommend that where saws are run on wheels 20" or less in diameter, that the gauge be correspondingly thinner. We build saws as light as 28 gauge for wheels as small as 12", but we advise against such small wheel practice in school shops.

TABLE OF NARROW BAND RECOMMENDED FOR VARIOUS SIZE WHEELS

Size of Wheel, Inches,	12	15	18	20	24	30	36	42
Gauge of Saw,	26	25	24	23	22	21	21	20

There are times when a gauge heavier than that given in the above table can be used to advantage, especially where the saw is running on a wheel 30" or larger. It is a good plan to have several saws on hand for taking care of variations in the required work. This is better than to force an undersized saw to do too heavy ripping or resawing, or to attempt to saw out short curves with a wide saw of too heavy gauge. Where the material is thick, and great accuracy is required, the heaviest gauge the wheel diameters will permit should be used.

Most sawyers favor a narrow band saw of 4, 4½, or 5 points to the inch for general sawing, while for very dry hard wood they use a finer tooth, say 6 to 8 points.

The angle of the front or cutting edge of each tooth of a narrow band saw is practically perpendicular or at about 80 degrees to the length of the blade. If the face of the tooth is undercut so that the face angle is less than 90 degrees it is said to have "hook." The best opinion seems to be that for curved and irregular shapes, either with or across the grain, a slight hook improves the cutting ability of the teeth.

For usual school shop work we do not recommend the use of much "hook."

The standard shape for narrow band saw teeth with practically upright face and 60 degree angle between face and back is illustrated (Figs. 31 and 32). This shape can be ordered in any spacing, the depth conforming, and being about 0.4 of the spacing distance.

When ordering a narrow band saw always specify (1) width, (2) length, (3) brazed or not brazed. On these specifications we ship saws of standard gauge and teeth, set and filed. For further details of gauge and teeth refer to catalog section on page 178.

Guides.—The function of the guide is to control side motion of the saw so that it will not scrape the sides of the slot in the table. It is also useful to support the blade against excessive twisting when cutting out

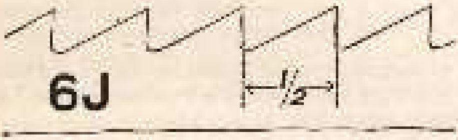


Fig. 31.—Proper shape for narrow band saw teeth, showing ½-inch space.

curves. The top guide is set from 4" to 8" above the work, depending on the nature of the job. It may be set at higher levels when cutting curves, to prevent twisting the blade too sharply. The bottom guide is fixed at a distance of 6" to 10" under the table.

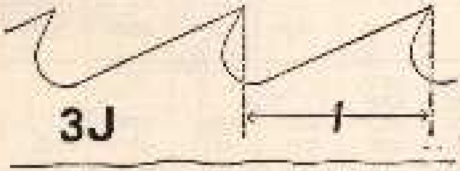


Fig. 32.—Band saw teeth showing hook (1 inch space).

At the back of the forked notch or slit in the top guide is a wheel so set that its face will rotate in contact with the back of the blade when the saw is under heavy thrust. The woodworker should see that this wheel can be easily turned with the fingers. The saw should just barely touch it and never be permitted to ride or press heavily against it. If the guide wheel spins when the saw is not cutting you can be sure it is running too heavily against the guide, and the upper wheel should be tilted to draw the saw forward slightly.

In addition to heating, or setting up strains and cracks, running the blade too hard against the guide causes a burr that affects the smooth operation of the saw on curves. When the guide has been raised higher than normal for a special job, be sure to return it to the proper level when the special work is finished. Carefully consider the figure showing a cross-section of a band saw blade in a curve. Impress on your pupils the error of trying to jam the saw through quick and excessive turns.

Section D

Band Saw Speeds

Narrow band saws are run at an average speed of 3500 ft. per minute, and the following table will be of assistance in quickly estimating the actual cutting speed of your band saw, based on the wheel diameter, and its R.P.M.

(Formula to determine speed in feet per minute: Diameter of Wheel in inches × .262 × R.P.M. equals Speed in Feet per minute. Example: 30 inch diameter × .262 × 445 R.P.M. equals 3497 feet per minute.)

TABLE OF R.P.M. TO GIVE SPEED OF BAND SAW IN FEET PER MINUTE

Diam. Wheel.	Speed of Saw in Feet per Minute:							Max. Width Saw, Ins.
		3000	3500	4000	4500	5000	5500	
20	R.P.M.	576*						½
24	R.P.M.	470*						¾
30	R.P.M.	382	445*	500	570			1½
36	R.P.M.	318	370	425*	477*	530	580	2
42	R.P.M.	270	315	360	405	450*	495*	2½

* Recommended speed for wheel.

Section E

Setting and Filing Narrow Band Saws

Setting

Narrow band saws are nearly always "spring set," the amount of set being proportional to the gauge and spacing of teeth. The bend of the set should be parallel to the line of the blade, and never below the middle of the teeth, as shown by the lines on the saw in Fig. 33. If the bend is made from the bottom of the gullet the saw is liable to bind in the cut at the shoulder formed on the teeth by such a bend.

The amount of set for general work is two to three gauges heavier over all than the gauge of the saw. In general, hardwood requires one gauge of set; dry soft wood, two gauges; wet or green wood, three gauges. Too much set causes excessive vibrating and a rough cut. Never set the teeth so wide that in looking down the blade the inner edges of the teeth do not lap.

Narrow Band Saw Automatic Setting Machine.—The machine shown in Fig. 177 is simple in its operation, practical in giving the teeth uniform set, and is built sturdily to give long and satisfactory service. It will set saws from $\frac{1}{8}$" to $1\frac{1}{2}$" wide, with teeth varying from $\frac{1}{8}$" to $\frac{3}{8}$" space. It sets the points of the teeth uniformly to the right and left, bending them along a line parallel to the cutting edge and above the center.

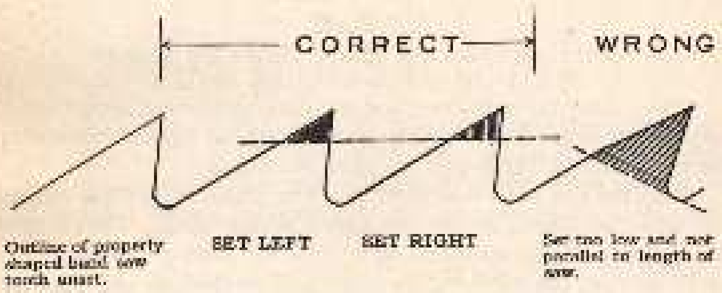


Fig. 35.—Proper setting of narrow band saw teeth.

Teeth are set alternately right and left. In brazing a band saw precaution should be taken to have it always contain an even number of teeth, so that in running the band saw through a setting machine there will be no odd tooth which has to be left unset.

The strain on a narrow band saw is greatly increased by running the saw dull or with unevenly filed teeth. It is necessary for any shop having any considerable quantity of band saw work to provide a convenient and efficient way of reconditioning these blades. The impression that the best filing and setting on narrow band saws is done by hand is largely a mistaken one, and many supervisors consider that it is a waste of time and effort for the busy instructor to spend his time filing band saws by hand. Nor should they be unduly imperiled by pupils experimenting on them with a file.

Note: It is not necessary to set a narrow band saw every time it needs filing. When setting is necessary, however, the saw should be set before filing.

Figure 178 illustrates the Narrow Band Saw Automatic Filing Machine, an essential machine for all larger woodshops using saws. It will take saws from 1/4" to 1 1/2" wide, with teeth 1/8" to 5/8" space, and will file old saws as well as new ones. If the saw has been frequently filed by hand previous to using the machine, it is better to go over it to equalize the teeth and assure regularity. It may require several times around to bring up all the short teeth, but the extra work will assure perfect operation from a saw that was doing only partial work previously. This machine uses 6" taper files and should be run at from 50 to 60 revolutions per minute.

Fitting Narrow Band Saws by Hand

Those who do not have the machine equipment described may sharpen narrow band saws by hand. Some special type of vise similar to that shown in Fig. 196 is used for hand sharpening.

Place the saw to be sharpened on a long bench so that it is supported throughout its length on the same level during filing. The clamp will hold a section of approximately 50 teeth at one setting. The saw is then moved so that one section after another is worked on until the entire length of the saw has been treated.

It is usual to slightly "joint" the section before beginning to file the teeth. This is done by lightly rubbing a flat file across the tops of the teeth to make them all of a uniform height. "Jointing" will also assist as a guide in filing, as explained later.

Before starting to file, consider the shape of the teeth shown in Fig. 33 on page 65. Keep the teeth on your saw to this shape. Use a 6" regular taper file for all band saws of less than 6 points per inch; a slim taper for all of 6 teeth or more per inch. Place the file in the gullet between the teeth and allow it to find its own bearing against the teeth it touches. Hold the file in a horizontal position. File straight across the saw (at right angles to the blade, raising your file on the back stroke).

If the point of any tooth is not brought up sharp after the stroke of the file, do not do extra filing to sharpen this particular tooth. Instead, continue until you have filed the section you are working on. By this method, each section may require two or three "goings-over."

Many instructors find that their narrow band saws may be filed three or four times before it is necessary to give the teeth more set. When required, the teeth may be set with our Triumph No. 28 Saw Set, in the same way that hand saw teeth are set. When setting is necessary, it should be done before the teeth are filed. It should be remembered that if the saw is to do only straight line cutting, best results are obtained by the least set possible. In this connection, remember that sufficient set is necessary to clear the blade in the cut, particularly when cutting on curved lines.

Section F

How to Use a Band Saw

Before using the saw see that the guard door over the upper wheel is closed, and that the saw is not binding in the guides or pressing against the back guide wheel. Be sure that the table of the saw is clear of small pieces of wood both on its surface, in the slot through the table, and on the lower wheel.

Before undertaking to use the saw, study the work to determine just how it should be cut, particularly on sharp curves and bends.

Set the guides at the correct height for the work. Allow the machine to get up to full speed and, if necessary, properly adjust the upper wheel before beginning the cut.

Whether curved work is sawed clockwise or anti-clockwise around the outline of the form, one hand acts as a turning point or anchor and the other hand serves to feed the work into the saw. Most often this pivoting and sawing alternates between the hands, or both of the hands are in motion as in straight ripping. This "pivot" principle is the basis for proper band-saw practice. The work should be turned so that the cutting edge of the saw is not twisted out of the plane in which it leaves the upper wheel. (See Fig. 34.)

The saw is not willing to overlook your mistake if you leave your finger on the work in its path. When at the band saw keep your thoughts on your work and on your own safety. Don't go mentally asleep.

Never attempt to pick small pieces of wood out of the groove of the table or brush cuttings off the table with the hands while the saw is in motion. The suction of the saw passing through the table will draw off most of the sawdust. What remains can be blown off, if necessary, before the saw comes to rest.

Before starting to cut, choose waste side of line in which the cut will be made. Do not attempt to halve this line. Run up to it or near it, if you want a cut conforming to the even curves of the figure being scrolled.

Fig. 36.—Working position at band saw.

If it is required to back off a cut, care should be exercised to avoid pulling the saw off the wheels. Withdraw the wood carefully, turning it so that the saw is never twisted out of a straight line.

Do not crowd the work to the saw if the saw labors in the cut. If the speed falls off greatly, you are trying to saw too rapidly, or the saw is dull. If it is the latter condition, do not fail to sharpen the saw as soon as possible. If the saw binds in the curves of the cut you are probably using too wide a saw. Again, a saw with insufficient set may bind, especially when cutting damp wood; proper setting will correct this trouble.

Before attempting to saw any lumber on a band saw examine it to be certain there are no hidden nails, screws, or foreign material to snap off teeth or break the blade.

Do not attempt to stop the wheel with the foot, or with a stick, after the power is shut off. Allow the saw to come to rest without interference.

Take the precaution to have a shut-off switch within reach of the operator's hand to stop the motor, otherwise, if the saw snaps, it may become entangled in the drive wheel and ruined.

Short bends and twists occurring when a blade is broken often set up small invisible cracks. These cracks may later cause breaks. The life of a saw is generally reduced more by one break than by months of cutting. Breaks that are attributed to crystallization are more often the result of small cracks formed by previous breaks.

Do not jam the saw in a tight curve or sharp corner.

If the saw can be felt to vibrate in the work as the braze passes through the slot in the table this should be corrected by filing the braze down to the same thickness as the rest of the saw. A carelessly joined saw prevents accuracy in work.

CHAPTER V

Circular Saws

Section A

General Information

CIRCULAR Saws are made in all sizes from small saws, 1¼" in diameter, for jewelers, to great saws, measuring 110" in diameter, for cutting the big trees of the West Coast. There are almost as many uses for circular saws as there are sizes: ripping, cross-cutting, cutting grooves, making shingles, sawing fibre and asbestos, making buttons, etc.

The circular saws used in school are usually from 6" to 16" in diameter and are either for ripping or cross-cutting or are of a special type made to do both. In this section we will discuss only those types of saws used in school shops. (For general information on circular saws see Chapter VI, "The Saw in History.")

Section B

How to Order Circular Saws

Complete information is essential in making up specifications for circular saws. Remember, circular saws are made especially for the kind of work they are to do. You will get a better saw for your work if you send accurate and complete specifications.

Information to give when ordering circular saws:

1. Type of saw wanted—rip, cross-cut, or hollow ground combination
2. Diameter in inches
3. Size of mandrel hole
4. Style of teeth wanted in saw
5. How many teeth wanted in saw
6. Speed at which saw will be run (R.P.M.)
7. What kind of wood will be cut

This lists the data required. Now let us consider each of these points in detail.

Diameter in Inches.—This is determined by measuring from tooth point to tooth point, through the center. Saws for school shops are usually from 6" to 16". When in use the saw should be just large enough to clear the center, or collar, and still cut through the stock.

Size of Mandrel Hole.—The usual sizes of Mandrel Holes in saws ranging from 6" to 16" in diameter are ½", ¾", ⅞", 1", and 1¼". In determining the size of mandrel hole, measure the size of the hole on your old saw with a steel rule or, better, measure the mandrel stem (where the saw is placed—not the shaft itself) with outside calipers and rule. It is not unusual to find mandrels smaller or larger than is standard for the size of saw to be used on them. Therefore, unless you give the size you may not be able to mount your saw in the machine.

Fig. 35.—Standard section of circular cross-cut teeth.

Fig. 36.—Standard section of rip teeth.

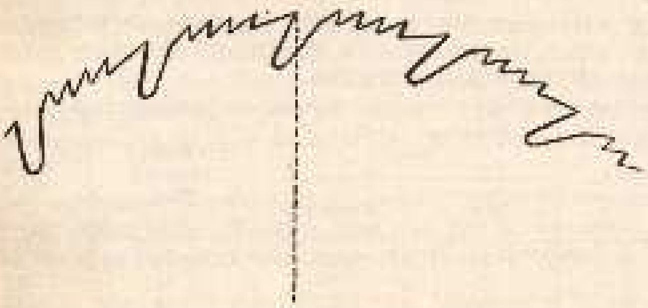
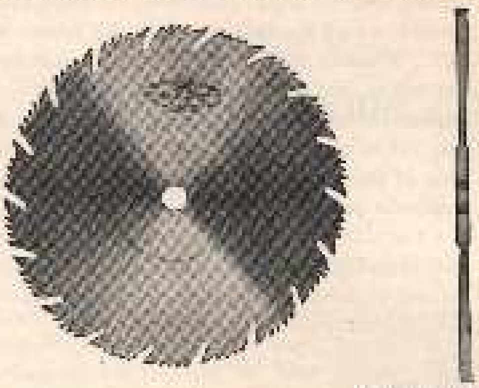


Fig. 37.—Standard section of new circular combination saw.

Style of Teeth Wanted in Saw.—The illustrations given in Figs. 35, 36, and 37 show the styles of teeth most commonly used in school shops.

Figure 37 shows tooth section of what is known as a "hollow-ground" saw. This means that the saw is ground to taper from the rim to the collar line. This "hollow-ground" type provides clearance without setting or swaging the teeth. In addition to the regular cross-cut and rip saws with set teeth, some hollow-ground combination saws for both



Hollow ground—no set.
Fig. 38.—Novelty combination saw for cross-cutting or ripping.

ripping and cross-cutting are needed for school shops because they give a finer, smoother cut. (See Fig. 38.)

TABLE BELOW SHOWS STANDARD NUMBER OF TEETH, MANDREL HOLE, AND GAUGE IN REGULAR CIRCULAR SAWS FOR CROSS-CUTTING AND RIPPING

Size	Standard Number of Teeth		Standard Mandrel Hole	Standard Gauge
	Rip	Cross-cut		
6	36	90	⅝	18
7	36	90	¾	18
8	36	90	⅞	18
9	36	90	⅞	16
10	30	72	1	16
12	32	60	1	15
14	32	60	1¼	14
16	32	60	1⅛	14

Saws can be had in any style of teeth and in almost any number of teeth. Number of teeth may be given as the number of points per inch (the "spacing" or distance from one tooth point to the next) or the total number of teeth in the saw may be given.

In general, the greater number of teeth in the saw the smoother the cut, because the more teeth engaged in the work at one time the more evenly is the cutting strain distributed throughout the saw. The larger the tooth the faster the cut, because, with large teeth and correspondingly large gullets, the saw will not fill up with sawdust and "choke down."

New Circular Combination ("Smooth Cutting") Saws.—These saws, made to run without set, are hollow ground for clearance and are used in school shops because they make an exceptionally smooth, even cut. The sizes in general use in schools are shown below:

Size, Inches	Gauge at Toothed Edge	Gauge at Edge of Collar	Gauge at Mandrel Hole
6	17	20	17
8	16	19	16
10	15	18	15
12	14	17	14
14	13	16	13

Specifications for saws of this type should give: (1) diameter of saw, (2) diameter of mandrel hole, (3) gauge at tooth edge. One style of teeth commonly used in school shops is shown in Fig. 37.

Speed at Which Saw Will Be Run. Speed is figured by the number of revolutions made by the saw per minute. This, of course, depends upon your equipment, but you should always determine it and state it in your order.

Saws are designed to run at from 7,500 to 10,000 lineal feet per minute on the cutting edge. Working from this, the recommended speed (R.P.M.) for saws commonly used in school shops is as follows:

Saws 6 inches in diameter 4775 R.P.M. (7,500 feet per minute)
Saws 8 inches in diameter 3830 R.P.M. (8,000 feet per minute)
Saws 10 inches in diameter 3250 R.P.M. (8,500 feet per minute)
Saws 12 inches in diameter 2860 R.P.M. (9,000 feet per minute)
Saws 14 inches in diameter 2590 R.P.M. (9,500 feet per minute)
Saws 16 inches in diameter 2390 R.P.M. (10,000 feet per minute)

What Kind of Wood Will Be Cut.—It will enable the manufacturer to serve you better if, in ordering your saws, you specify whether, in general, hardwood or softwood will be cut with the saw.

Section C

How to Use Circular Saws

Circular Saws that have been carefully set and filed are often damaged, even before they are used, by pushing them against the slot in the table when turning the mandrel into cutting position. Before turning on the power, saws should be revolved by hand to make sure they clear the slot in the table and are running freely.

If the material to be cut has been used before, it should be examined carefully for nails or other metal.

The saw should be adjusted to the correct height above the table for the material to be cut, with the guard in place.

The gauge (or the guide on the table to determine the width of the cut) should be set to the width of cut desired by measuring from the face of the saw.

The proper position for the operator of the machine is to stand to the left of the board to be cut, with the left hand held tightly on top of the work in advance of the right hand, which supports the rear of the piece to be cut. The left hand is not advanced as the material is fed into the saw, but is held stationary and the work slid under it.

It is important that the operator does not stand directly back of the work. If, for any reason, the material should become pinched and be thrown back, it would probably injure anyone directly in front of the saw.

Careful operators use a "push stick" (a short piece of lumber, usually notched at one end) to force small pieces of lumber through the saw. In making wide cuts the push stick is not ordinarily used.

Never permit a saw to be used unless the guard is in place. (See Fig. 39.) Never use it yourself without the guard. You could do this undoubtedly without danger to yourself, but some pupil will attempt to follow your example and suffer thereby.

Be sure to do everything possible, by lecture and demonstration, to impress upon pupils the necessity of being awake and thinking of each move before it is made.

It is important to have installed near the operating position some convenient means of stopping the machine quickly, either by foot lever or hand switch.

The saw always should be brought to a full stop before the angle of the table, or the depth of set of the saw, is changed.

If the saw howls when it is up to full speed, this indicates that one or several things may need adjustment. It may be that the locking nut on the mandrel is not properly tightened and the saw is wobbling. It may be that the mandrel journals are not smooth and are running too tight.

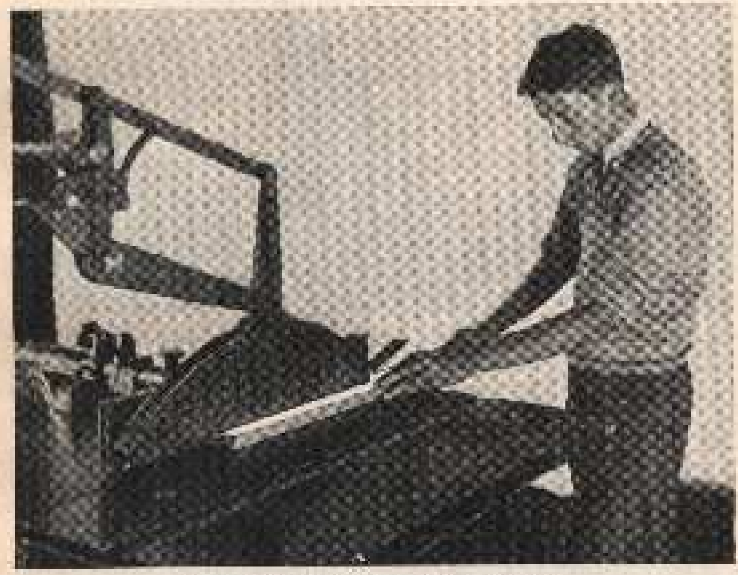


Fig. 39. Correct position at circular saw.

The saw may have lost its proper tension (if it is an old saw), or the speed may be either too low or too high. With a belt-driven machine the chances are that the speed is too low, and with direct drive the possibility is that the speed is too high.

A saw sometimes howls because the teeth are improperly beveled. The teeth of cross-cutting saws are beveled on both the face and the back, one tooth being beveled to the right, the next to the left, and so on, with the high corner on the outside. The rip saw is filed "straight through" or square to the side of the saw on the face, and beveled slightly in the same way as a cross-cutting saw on the back. The setting is the same as on cross-cutting saws. The bevel should never extend into the gullets. A saw for cutting hardwood requires less bevel than a saw for cutting softwood. (See Figs. 40 and 41.)

If the work "jams" as you are cutting it, do not attempt to force it through. Rather, withdraw the material and go again through the entire cut to increase the width of the kerf. If the saw still binds, examine the saw to see if it has the proper amount of set and is sharpened properly.

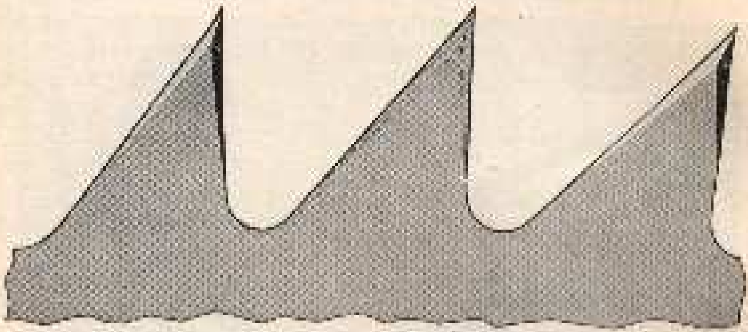


Fig. 40.—Bevel and angle of teeth of circular cross-cut saw for softwood, magnified.

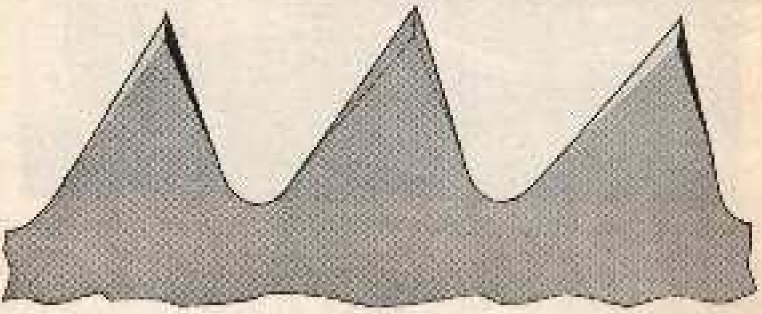


Fig. 41.—Bevel and angle of teeth of circular cross-cut saw for hardwood, magnified.

The exertion of undue pressure when the saw binds may result in injury to the operator or breakage of the saw. Undue pressure on the saw may destroy the tension, thus forcing the saw out of a true line. In this case burned (blue) spots appear on the side of the saw. Usually, preceding this damage, smoke is noticed coming out of the cut.

To a large extent correct operation and running of the saw depend on the condition of the collars. The stationary collar should be flat at the outer edge for from ½" to ¾" toward the center. This gives a vertical supporting face for the saw. From this point to the junction with the shaft, the collar should bear away from the vertical to a slight concavity at the shaft. The loose collar should be similar in shape, flat at the outer edge, and concave toward the center. This assures that the rims of the collars press the saw firmly and that the saw will run true when up to its proper speed. Be sure that the collars of your saw are correctly faced and large enough in diameter.

Tension.—Anyone who uses circular saws should understand the principle of tension. Tension may be explained as a condition set up in the saw blade by hammering which neutralizes the effects of centrifugal force on the saw when run at its designed speed. In the operation of tensioning, the saw blade is so hammered that the rim of the saw becomes firm and the center "open."

Small circular saws for ripping and cross-cutting, such as are used in schools, are rarely given much tension. They are run very nearly flat throughout.

On small circular saws lumps or burned spots will be noticed if the saw has been abused and the saw needs to be retensioned. This work is properly a factory job, and we maintain a department of skilled workmen to remove lumps or ridges and put the saw under proper tension again.

Section D

Pointers on Circular Saws

Give attention not only to the fact that saws are designed to run at a rim or cutting speed of around 10,000 ft. per minute, but that this speed should be uniform as far as possible.

Do not use a saw that is too thin. The advantages of evenness of cut, life of cutting edge, and ability to stand overwork that come with the use of a saw of standard thickness should not be sacrificed in an effort to save a little lumber by using a saw that is too thin. For longer, more satisfactory service in school shops, we recommend saws of standard gauge as shown in the table on page 72.

If the gullets of the teeth of a circular saw are too small for the feed, a harsh vibrating sound will be heard as the saw leaves the cut, and it will be difficult to push the lumber into the saw. To get a smooth cut many woodworkers order saws with a larger number of teeth than standard, and then try to force this saw to do the work of one with large gullets. The resultant crowding of the gullets causes this scraping vibration. On the other hand, too few teeth will result in a rough cut, in undue strain on each tooth, or in cracking, particularly when the saw becomes dull.

Failure to properly "joint" the saw (or make the points of the teeth all the same distance from the center) before filing will cause the saw to be out of round, throw excessive work on certain teeth, and cause the saw to run out of balance. It may result in broken teeth and in heating at the rim.

Causes of Heating at the Rim:

1. Running saw when dull.
2. Teeth with too little set or swage for clearance.
3. Teeth with insufficient gullet space.
4. Teeth with too little clearance on back.
5. Gum or resin sticking to the sides of saw at teeth.
6. Running saw when dished or when not level on face.
7. Improper tension, i. e., too little tension, so that saw is too stiff in body.

Causes for Heating at Center:

1. Improper tension, i. e., too much tension, so that saw is too loose in body.
2. Speed insufficient to take up the tension in the saw.
3. Heating of journal next to saw.
4. Saw having too much "lead" in or out of work.

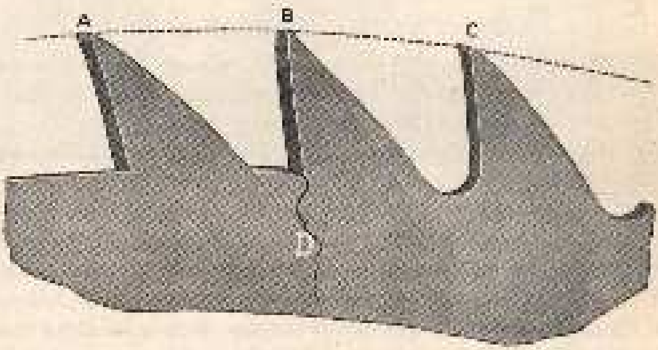


Fig. 42.—Crack resulting from square gullet, magnified.

Cracking of Circular Saws.—In small saws at least 60 per cent. of the cracks occur at the base of the teeth which have not had the gullet properly gummed or filed so as to retain the curve shown in Figs. 42 and

43. Among the other common causes of cracks are too much or too little bevel on the face of the teeth, causing strain on the tooth, insufficient clearance on top of tooth, teeth too long or too slim, and sharp angles in gullets.

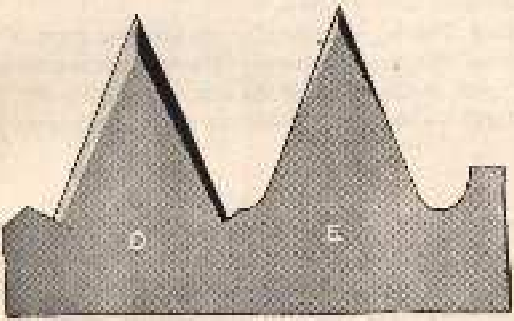


Fig. 43.—Incorrect (D) and correct (E) bevel for circular cross-cut saw teeth, magnified.

If the crack has not progressed too far, it can be arrested by drilling a small hole through the saw at the end of the crack, or by a center punch dot at this same point, on both sides of the saw.

Section E

Refitting Circular Saws

If in previous refitting of the saw the original design of the tooth has been so greatly altered as to affect the operation of the saw, it is better to return the saw to the factory for a complete overhauling. Where certain teeth lack uniformity, or where the angle of the front of the tooth has been slightly changed, this condition can be corrected by refitting. In refitting the operations are, in their proper order, as follows:

Jointing.—This operation assures that all the points of the teeth are the same distance from the center. Unless the saw is properly jointed an undue stress is put on certain teeth when the saw is in use, and the saw may be strained and cracked.

The saw should be adjusted so that the higher teeth just score a piece of wood held flat on the table over the top of the saw. Then substitute a piece of soft emery wheel for the wood, run the saw at slow speed, and move the emery back and forth across the teeth at right angles to the direction of the saw as it revolves. Raise the saw a very slight amount, continue the use of the emery wheel, and gradually wear away these high teeth until examination shows that all teeth (excepting raker on combination saws) have been touched.

Reshaping Teeth.—For circular rip saws the front of the teeth is, in general, about 30 degrees under-cut from a line drawn from the extreme point of the tooth to the center of the saw, as shown in Fig. 44, while the back of the teeth is about 10 to 15 degrees under the tangent to the radius.

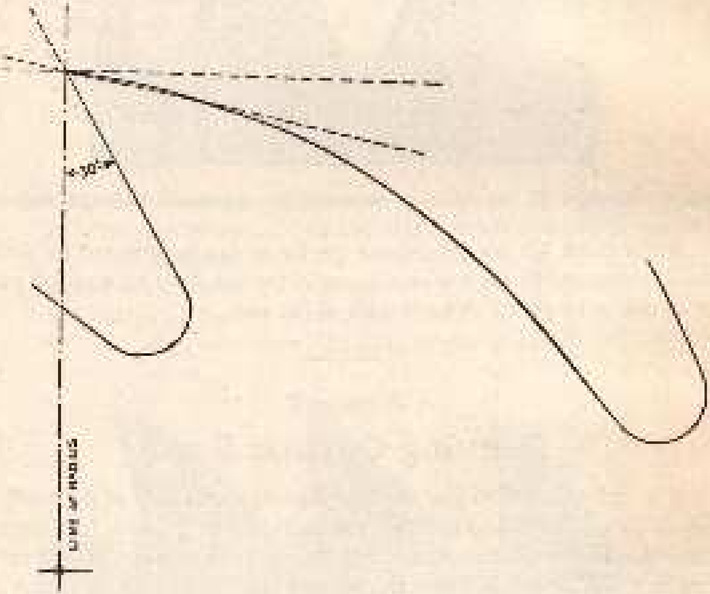


Fig. 44.—Correctly designed rip saw tooth.

For circular cross-cut saws the front of the teeth is either in line with the radius or sloping backward at an angle of 10 to 15 degrees, as shown in Fig. 45. In the case of the peg tooth, the front slopes back 30 degrees, the front and back of this tooth (an inverted V) being sloped alike, see Fig. 45. In general it can be stated that the greater the angle of the "face," or the front of the tooth, the smoother the cut. Also, the harder the wood, the greater the angle. This is shown in Figs. 40 and 41.

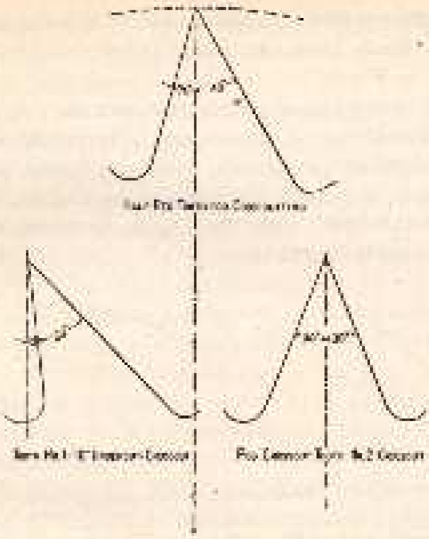


Fig. 45.—Three designs of circular cross cut teeth.

First Filing.—Place the saw in a vise suitable for holding the teeth at any even distance above the jaws, the best arrangement being a vise so made that the screw forms an arbor which permits the saw being revolved as each tooth is brought up for filing.

In sharpening, a saving in time and files is effected by using a full stroke of the file instead of a scraping one. Figure 46 indicates the original line of the rip tooth on a new saw; dotted line BB shows where the point first wears; dotted line CC shows how the tooth should be filed to restore its proper cutting face. Too frequently, on account of the long surface to be filed, operators file only the top of the tooth, as represented by the dotted line DD. This should never be done.

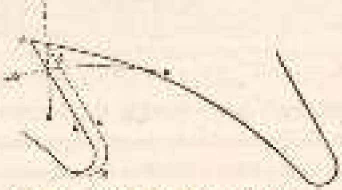


Fig. 46.—Proper filing of rip tooth.

Rip saw teeth are filed straight across, square to the side of the saw on the fronts. Each alternate tooth is very slightly beveled on the back, as shown in Fig. 47.

If, instead of being spring set, the rip teeth are to be swaged (that is, the point of each tooth spread so as to cut the kerf wider on each side of the saw than the thickness of the saw itself), the teeth are filed straight across on the front and back, the tooth being filed on the back to fit a gauge which is furnished with the swage, or which conforms to the straight-faced notch in the swage.

Fig. 47.—Bevel on back of circular rip teeth.

Cross-cut teeth are given more bevel front and back, as shown in Fig. 48. Also it is well to note the difference in angle of the front of the teeth for cross-cutting soft- or hardwood, as illustrated in Figs. 40 and 41.

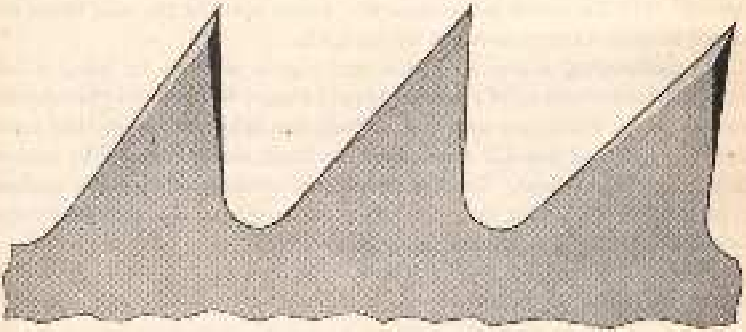


Fig. 48.—Correct "fitting" of circular cross-cut teeth.

In filing a combination saw (see Fig. 37) care must be exercised to maintain the original shape of the cross-cut and raker teeth. An 8" slim taper file is placed in the gullet between cross-cut teeth so that it rests on the front face of a tooth whose high point is away from the filer. The file is tipped upward and forward toward the raker tooth, and the stroke is in the same plane as the back of the cross-cut tooth nearer the raker, but most of the metal is removed from the face of the other tooth which is in contact with the file. In this manner the proper angle is filed on the front of all cross-cut teeth whose high points are away from the filer. The saw is then reversed in the vise and the other teeth similarly filed. The raker teeth are filed on their back and slightly dressed on their face so as to bring their points about $\frac{1}{64}$ of an inch below those of the cross-cut teeth. This is best tested by noting the bottom of the kerf cut by the saw.

If the bottom of the cut shows square, the raker tooth is doing all the work. The raker should be sufficiently lower than the cross-cut teeth to allow the marks of the points of the cross-cut teeth to be just visible as lines at the edges of the bottom of the cut.

Regumming.—A circular saw is said to be properly gummed when the gullets between the teeth are correctly and uniformly shaped. It is particularly important that they be free of sharp corners or notches such as shown in Figs. 42 and 43. The cracking of circular saws at the rim or the breaking out of teeth are caused in many cases by failure to maintain the original arc-shape in the gullets of the saw. Sharp edges or notches in the gullets are usually caused by an edge of the file rubbing into the gullet during filing of the teeth.

As a precaution in filing circular rip saws it is better to use a mill file with two round edges, so that any contact with the bottom of the gullet will tend to maintain a curve rather than make notches.

If the bottom of the gullets of circular rip saws get as badly out of shape as shown in Fig. 42 it is dangerous to run the saw. In such a case the saw should be returned to our factory and regummed by our saw makers. During the refitting of a rip saw in the school shop use a round file to restore the normal shape of the gullets. The file should be turned on its axis or drawfiled as it is pushed through the gullet. If, in order to remove notches in the gullets, the gullets have been deepened, be sure to equalize all the gullets accordingly, to maintain proper balance of the saw.

In like manner the gullets of cross-cut saws, while relatively smaller than on rip saws, call for careful attention. (See Fig. 43.) The precaution to refit the saw with taper files (that is, files with rounded edges) will insure a properly rounded gullet between teeth.

Setting or Swaging.—Unless the saw is hollow ground it should be given means of clearing the blade in the cut. This is done either by setting alternate teeth to the right and left (or by swaging in case of rip teeth). For saws below 16 inches in diameter the teeth are usually set rather than swaged, while the method is reversed in larger saws, which are usually swaged.

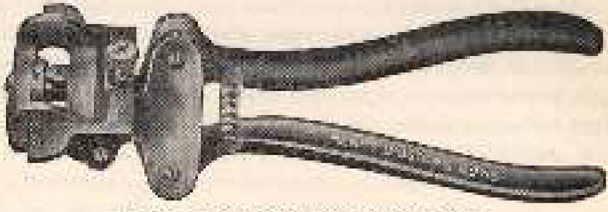


Fig. 49.—Triumph saw set for circular saws.

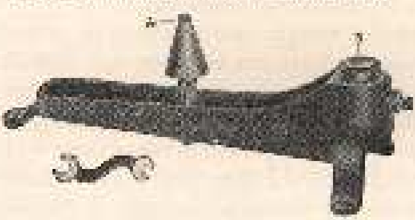


Fig. 50.—Setting stake for circular saws.

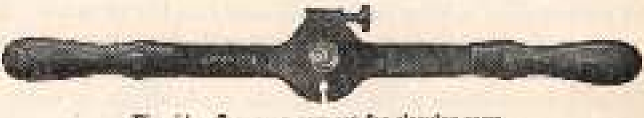


Fig. 51.—Sampson saw set for circular saws.

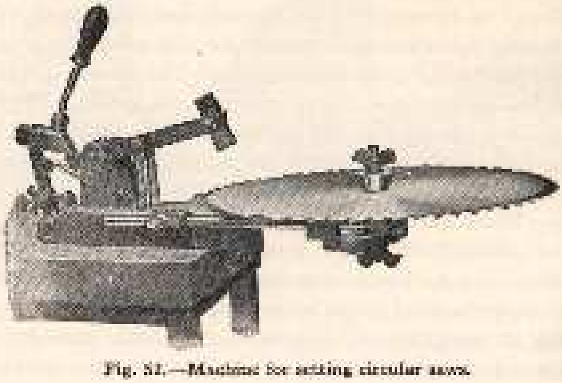


Fig. 52.—Machine for setting circular saws.

Spring setting can be done by a setting stake such as shown in Fig. 50, by the Disston Machine for Setting Circular Saws (Fig. 52), by a Triumph Saw Set such as the Disston No. 18 (Fig. 49), or by Sampson Saw Set (Fig. 51).

In all cases these tools provide a means for bending the teeth alternately to the right and left a uniform amount, usually about two gauges more than the thickness of the saw. Probably the most effective tool on the market is that shown in Fig. 50. The cone A is moved in or out to suit the diameter of the saw. The saw is made to lie so that the edge of the saw is supported by the flat surface of the anvil, and the amount of set can be changed by moving the anvil until the face wanted is in contact with the tooth

Fig. 53.—Conqueror swage for circular saws.

Some operators of circular rip saws prefer a swaged tooth. Swaging is best done by the Conqueror Swage as illustrated in Fig. 53. Care must be exercised to swage from the front of the tooth rather than the back, otherwise the cutting edge of the tooth will be raised and the teeth will be of uneven distance from the center, and certain teeth will be required to carry more of the load than others. Hold the convex or upset notch of the swage against the tooth and by striking it with light hammer blows spread the tooth about two gauges on either side of the saw, as shown by the section of the tooth in Fig. 53. Hold the swage at such an angle that the contour of the backs of the teeth are not changed. This can be checked by having the swaging marks show principally on the fronts of the teeth where the filing will be done.

We recommend a special tool, called the Disston Eccentric Swage, for saws of 22" and over. On school saws quite satisfactory results can be obtained by our hand or Conqueror Swage.

Rejointing.—When the operator is inexperienced in setting or swaging it is well to lightly rejoint the saw at this point (see Instructions for Jointing, page 79) to assure uniform cutting of all teeth.

Second Filing.—All the teeth should be gone over to bring them up to a keen point, the same angles retained as were used in the first filing. The only filing that should be done on the back of the teeth is just enough to remove the marks of the emery made during rejointing.

If the teeth have been swaged, due care must be taken to file square across the teeth so that all the cutting edges will be at right angles to the side of the saw. If the swaged saw is not filed in this manner it will lead in or out of the cut toward the side of the saw bearing the high corners.

Side Filing.—The next operation consists of "side filing," which means bringing all the points to a uniform width. It is very difficult to swage or set a saw so accurately that all the teeth extend a uniform distance from the side of the saw. A slight variation in the widths of the cutting points will not only cause the saw to labor in the cut, but will make rough edges on the wood. It is best to use a Disston improved side file, shown in Fig. 54, to secure a uniform width on all teeth. The side file is adjusted by set screws to conform to the width of set desired, and the sides of the teeth are dressed off to remove any unevenness or overhanging of corners.

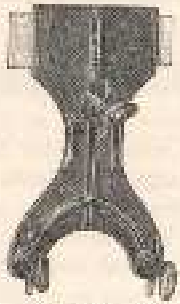


Fig. 54. Side file for circular saws.

On combination saws, which run without set, an oil stone should be passed along the sides of the teeth to remove the feather edge, if any has been formed during the filing.

Inspecting.—Before the saw is run it should be examined for the accuracy and uniformity of the fitting. Especially note whether the clearance is even and about three or four gauges wider than the body of the saw. On rip saws, examine the back clearance of each tooth, which should be sufficient to clear the back of the tooth without scraping. Approximately ten degrees below the tangent to a radius drawn to the point of each tooth is good practice. Likewise the bevel on the teeth, the length of teeth, and the uniformity of shape can be inspected before the saw is run.

Important Advice.—If the work outlined is carefully done the saw will now be ready to mount and run. However, it should be resharpened before it becomes so dull that there is a tendency to pull hard, leave a true line, or heat up. Many saws are ruined and danger threatens the operator who runs his saws after they are dull. In general, any circular saw will stand two or more filings before it needs resetting or reswaging, or has to be regummed. A saw is like any other cutting tool. It will only work satisfactorily as long as it is kept in proper order and has a sharp edge.

We are in position at our factory to furnish reliable refitting service on any size or type of saw. Our saw makers are glad to put your saws in perfect condition at your convenience.

CHAPTER VI

The History of the Saw

Section A

Early History

NO ONE knows definitely where saws were first used. No one knows how they were first used, or the reasons for their original employment.

It is established, however, that the saw was one of the very earliest tools employed by man. Archaeologists estimate that the saw dates back at least to the Neolithic, or later Stone Age. This means that man used saws before the discovery of metals, though they were naturally very crude implements.

It is generally conceded that nature provided the examples which inspired the invention of saws.

A Grecian fable, describing the origin of the saw, relates how Talus (or Perdix), having found the jawbone of a fish (according to some authorities, a serpent), produced an imitation by cutting teeth in iron.

While the Grecian claim to discovery is unsupported by historical authority, such an origin seems probable.

The earliest prehistoric saws were simply flakes of flint, notched by chipping. They were rarely more than 3 inches long, with irregular teeth of doubtful sharpness. Held between the thumb and finger, these saws had very limited cutting power.

These saws were used chiefly in the manufacture of ornaments from bone and soft stones.

Excellent specimens found in the north of England are shown in Fig. 56. Greenwell, in his "British Barrows," says of the saw at the right in Fig. 56, "This instrument is very like a lance point, sharpened and thin at the base, where it was fastened to the haft; but from the many teeth at regular distances from each other, I am disposed to think it has probably been a saw."

Saw found in a tomb in Thebes, Egypt.

Fig. 35.—Ancient stone and metal saws.

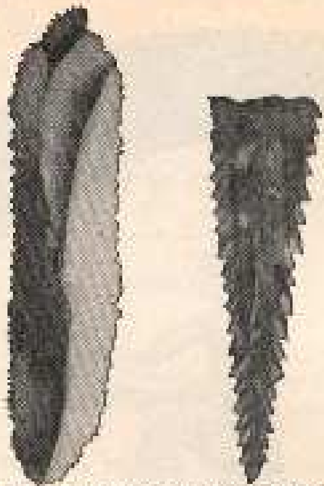


Fig. 56.—Notched flint saws found in England.

Flint saws have been discovered in the caves of the "reindeer period" in France, in the Kjokken-Moddings (ancient stone heaps) of Denmark and Sweden, in the lake dwellings of Switzerland and northern Italy, and practically throughout Europe. The smallest discovered is 1½ inches in length and none has been found longer than 9½ inches.

Fig. 57.—Primitive saws of the stone age.

Figure 57 illustrates some of the primitive types. The center figure appears to have been used both as a knife and a saw, and there are indications that some of the specimens once had wooden handles.

Even the dweller in the Stone Age recognized the need for a handle on his saw. He eventually worked out a method of mounting his serrated flint chip in a grooved stick.

Fig. 58.—Flint chips mounted in ancient wood stock.

The finest specimen of this type (Fig. 58) was found in the prehistoric region of Polada, in northern Italy. Four separate flint flakes are cemented into the wooden casing with asphalt.

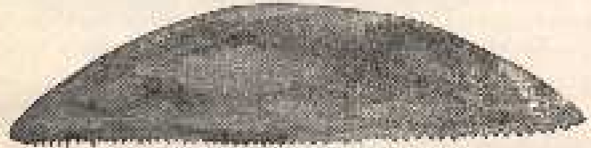


Fig. 59.—Primitive Scandinavian flint saw.

In Scandinavia, where flint is found in large blocks, the primitive saws were larger and half-moon shaped (Fig. 59). The teeth are on the straight edge, which is from 4 to 7 inches long.

Specimens of bronze saws which supplanted those of stone are rare, not more than about thirty having been found in all Europe.

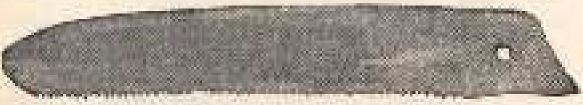


Fig. 60.—Nine-inch bronze saw, Swiss lake.

Fig. 61.—Stone mold for casting bronze saws (Swedish).

A perfect blade about 9 inches long (Fig. 60) was taken from a lake dwelling at Moeringen, Switzerland. Others have been found in France, Spain, Hungary, Italy, and Sweden, and in the last named country was found a stone mold for casting bronze saws, in which four could be cast at once (Fig. 61).

Prof. W. M. Flinders Petrie, the eminent Egyptologist, who estimates that this ancient civilization is 12,000 years old, discovered indisputable evidence that bronze saws with jewelled teeth were used by the ancient Egyptians for cutting the hardest stone.

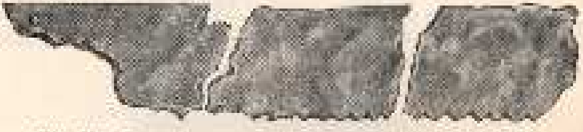


Fig. 62.—Section of bronze saw from ancient Nineveh.

Sir Austin Henry Layard, the Assyriologist, found at Nimroud near Nineveh, a two-handled iron saw (Fig. 62) 3 ft. 8 in. long by 4½ inches wide. (Dimensions similar to those of the present-day saw.)

Fig. 63.—Obsidian blades from Valley of Ur.

Two blades of obsidian, or volcanic glass, were discovered in the graves of Tell-El-Obeid at Ur of the Chaldees, Mesopotamia. Archaeologists agree that these blades, shown in Fig. 63, are between 6000 and 7000 years old. They are now at the University of Pennsylvania Museum in Philadelphia.

Although it is one of the simplest and oldest of tools, it was not until the last two or three centuries that the saw attained its universal importance.

Iron was necessary in its construction. Stone saws had no real value, and those of bronze were little better.

The invention of steel was a powerful stimulus to the development of the saw. The date of its discovery is lost in the past. Hesiod in 850 B. C. refers to "bright iron" and "black iron," and Ezekiel in 600 B. C. to "bright iron." This latter was undoubtedly a low-grade steel.

The mention of its importation from Chalybes to Greece is the first authentic mention of steel.

From ancient history we learn of the wonderful Persian and Damascene sword blades of steel (335 B. C.), while Diodorus, a Greek, wrote in 60 B. C. of the Celtiberians as being "armed with weapons of excellent temper."

The development of the saw has been more rapid in comparatively recent times than in any other period. The real beginning of modern wood-cutting types dated from the introduction of the power mill—the early reciprocating, "up-and-down" mill, paving the way for later improvement.

Crude as were these old-fashioned upright saws, they were a big improvement over the previous method of sawing a log with a man in a pit beneath it and another standing above.

The earliest saws were driven by wind power, but a 13th century manuscript shows a water-wheel saw.

Germany had water power mills as early as 1322 (Augsburg). Holland had saw mills nearly a century before England, where workmen refused to permit their introduction (Fig. 64).

In 1663 a Hollander erected the first saw mill in England, near London, but it had to be abandoned because of the riots it occasioned among the hand-sawyers.

More than a century later, in 1768, a wind power mill was erected for a lumber merchant by the name of Houghton, but this, too, was torn to pieces by a mob.

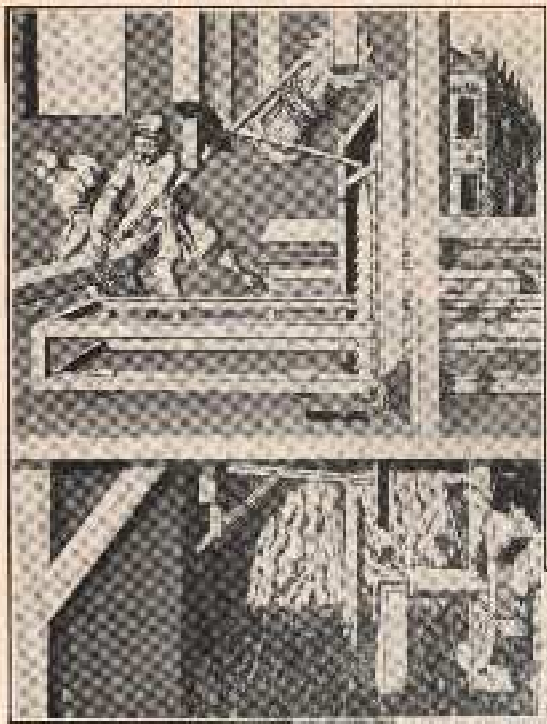
The rioters were severely punished and the owner reimbursed by the government, under whose protection several mills were built.

America's first authentic saw-mill was built at the Falls of Piscataqua, on the line between Maine and New Hampshire, in 1634 (Fig. 65).

Unauthenticated records, however, claim that as early as 1633 several mills were operated in New York State.

In 1803 there was a steam saw-mill in New Orleans, which met the fate of the early English mills, being burnt by hand sawyers.

The earliest patent on circular saws is No. 1152, granted to Samuel Miller in England, August 5, 1777, although it is claimed that similar saws were in use in Holland nearly a century before.



First use of water power in a saw mill.

Fig. 64.—Old saw-mill using horse power.

Fig. 65.—Type of first American saw-mill.

The first circular saw in this country is supposed to have been made by Benjamin Cummins about 1814 at Bentonsville, N. Y., his facilities consisting solely of the ordinary tools and equipment of a blacksmith's shop.

The general use of circular saws for manufacturing lumber is supposed to have originated in a patent granted March 16, 1820 to Robert Eastman and J. Jaquith, of Brunswick, Me. Since then countless other circular saw-mill patents have been granted.

Water, and later steam, was the motive power of these saws.

Many years ago 48-inch circular saws, driven by "four horses walking around," were used in our Western States.

The early circular saws were very crude, with square mandrel holes, and were made to special order.

After 1840 progress was rapid. The development of the inserted tooth at about this time was one of the greatest progressive strides ever taken in saw-making.

The problem still confronted saw makers, however, of reducing the

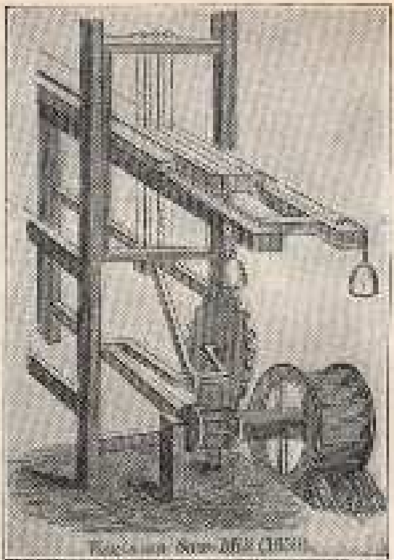


Fig. 56.—Water-driven saw mill in Virginia (1650).

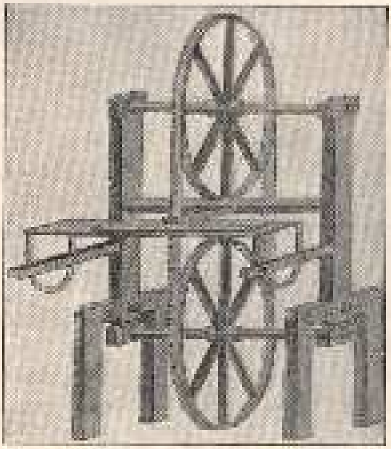


Fig. 57.—Original band saw of 1808.

time and power consumed, as well as the waste in sawdust, in converting logs into boards. Eventually the perfecting of the band saw proved to be the solution.

William Newberry, of London, England, patented the first endless band saw in 1808.

Although Newberry was the first of modern times to see the possibilities of the band saw, he cannot justly be said to have originated it.

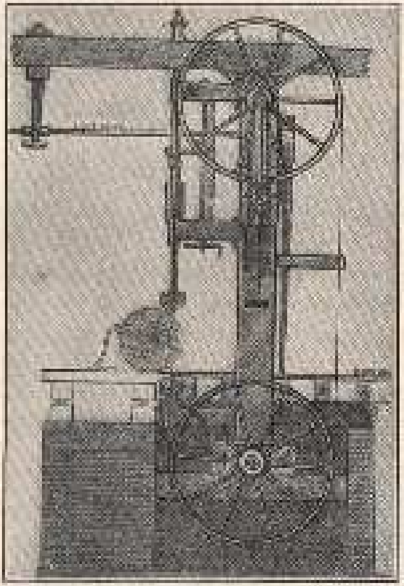


Fig. 58.—One of the first band-saw machines.

Archaeologists have brought to light proof that in numerous instances the band saw has been brought very nearly to its present form by ancient peoples.

One of the stumbling blocks in the development of the band saw was the difficulties experienced in making a smooth strong joint in the steel band.

To Perin, of Paris, is due the credit for the improvements which made the general use of the band saw possible.

The large proportions and perfection of form of the present-day band saws are strikingly shown in comparison with those even of so recent a period as 1876.

A band saw 6 inches wide, exhibited then at the Centennial Exposition, Philadelphia, by Henry Disston and Sons, was considered a wonder; today the same firm is regularly making band saws 18 inches wide, many of them toothed on both edges to cut the log coming and going.

This up-to-date, speedy band saw has increased the productivity of mills to a point never dreamed of by the mill man of bygone days.

Section B

The Modern Saw

It is a long step from the crude primitive stone implements illustrated in the previous chapter to the modern saw employed today, which is evidence of the extraordinary industrial progress made by man. Replacing the crude chipped stone of prehistoric days we now have a tool of utility and beauty made in numerous shapes and sizes for a great variety of purposes.

This section will deal chiefly with those saws commonly found in the school shop or household. Those desiring further information will find the subject fully treated in another Disston book called "The Saw in History."

Saws may be considered under two heads—reciprocating and continuous. These again may be divided into other classes.

First, we will consider reciprocating saws, for saws of this kind are more generally used.

Hand Saws

The hand saw, of which the Disston No. 7 and D-8 are distinctly the representative types, is now the companion of most mechanics who have anything to do with wood in their daily work. It is safe to say that the hand saw is also found in the vast majority of the homes of the entire world.

Broadly speaking, the term "hand saw" includes such saws as back, buck, keyhole, plumbers', pruning saws in different forms, and many others for special purposes.

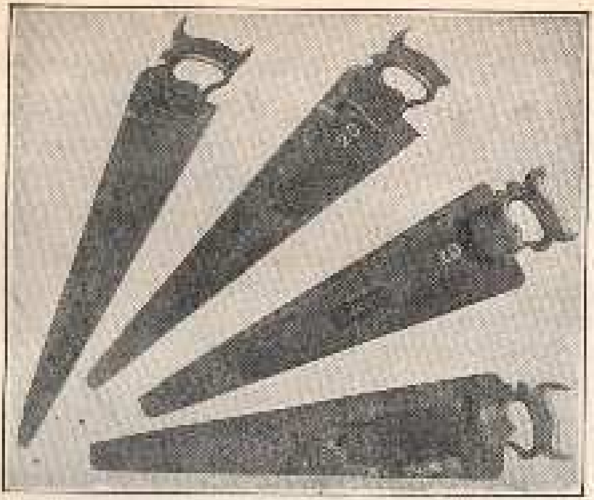


Fig. 69.—Early types of hand saws.

Although each type is of essentially different construction from the others, because of the nature of the work it is called upon to do, the principle and origin are the same.

All modern hand saws except those of the Japanese cut on the push or the stroke away from the user. (See Fig. 70.)

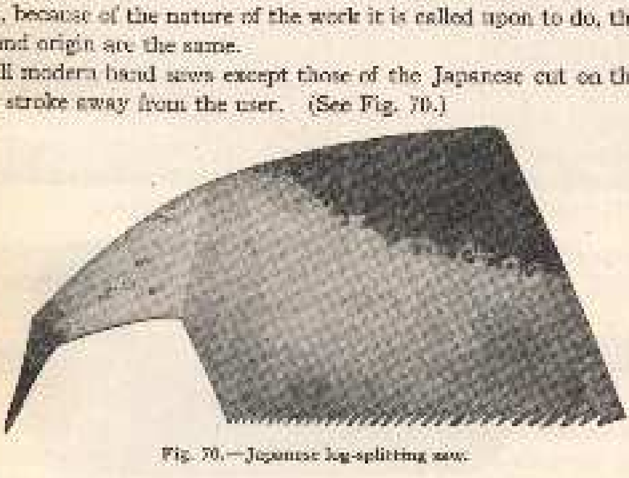


Fig. 70.—Japanese log-splitting saw.

While the oldest civilized peoples in the world—the Egyptians, the Chinese, and the Japanese—used a form of saw having the teeth inclined toward the handle, this form was not universal, as is evidenced by the saws exhumed from the ruins of Pompeii, and preserved in the museum there. These saws cut on the thrust, just as those in use in Europe and America today.

The standard type of hand saw is, of course, a direct development of the piece of stone with a serrated edge as used in ancient times.

The present shape of the hand saw, which differs somewhat from the earlier type of hand saw, is an invention of Henry Disston. What he did was to take the fundamentals of the earlier designs and combine them into a saw that was better equipped for speed and easy cutting than anything that preceded it.

He made the blade "skew-back," as it is termed, to lessen the weight of the blade and give proper balance as well.

He "let-in" the handle to give better control over the saw, while the peculiar shape of the butt or heel allows full sweep of the blade without danger of its catching in the work.

Continuous Action Saws

The saw forms so far described are the oldest type—Reciprocating Saws, used principally by hand to cut on the thrust or pull.

We now come to Circular and Band Saws, continuous-action saws whose invention and development revolutionized the methods of lumbering and woodworking.

The principal types of continuous action saws are the Circular, a rotating disc; the Cylindrical (see Fig. 71) or barrel shaped; and the Band Saw, which is a continuous ribbon of steel running on two wheels.

The early types of Circular Saws can hardly be compared with those of today, so great has been the advance in manufacture.

Fig. 71. Cylinder saw for cutting tight barrel staves.

The first Circular Saws were made flat and thick throughout, many of them being as heavy as 3 or 4 gauge, that is, about ¼ inch thick.

The speeds at which they ran were low, and they were not greatly affected by centrifugal force. These saws, consequently, were hammered perfectly flat, without "tension."

The Circular Saw of today, on the other hand, is thinner, 9 and 10 gauge, or about $\frac{1}{8}$ inch, thicknesses are not unusual. For example, a standard 12-inch saw is 15 gauge or $\frac{1}{14}$-inch thick. The present standard rim speed is from 7500 to 10,000 feet per minute, and some saws run at even higher speeds than this.

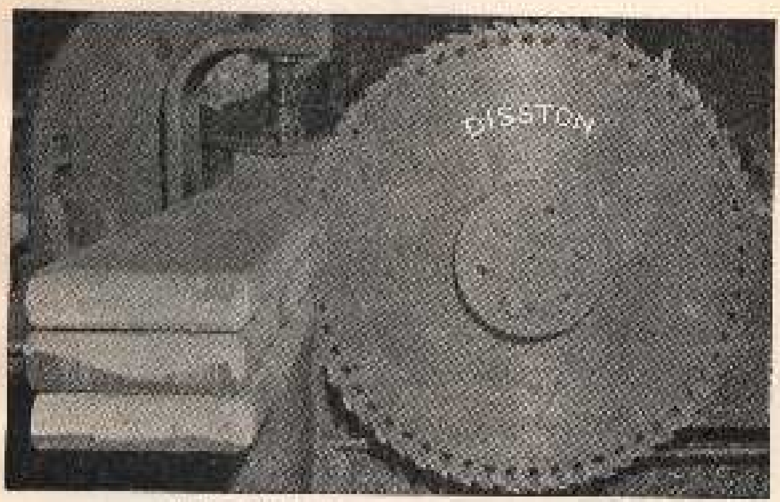


Fig. 72.—Fifty-inch inserted tooth metal cutting saw.

The action of centrifugal force at such speeds has to be reckoned with, and saws are therefore hammered to give them what is known as "tension."

Another great improvement is in the tooth. Instead of the ordinary V-shaped tooth, there are hundreds of patterns or special shapes for ripping, special styles for cross-cutting—each made on scientific lines to give the necessary "pitch" and "lead" into the cut, as well as ample throat room for carrying out the sawdust to prevent choking; special sizes or number of teeth according to the class or character of the wood to be sawn and also the amount of feed used.

Solid tooth types of Circular Saws are the ones most commonly used, for the reason that they are applied to the greatest variety of work.

These can be divided into two principal classes, those intended for the sawing of wood, and those adapted to metal cutting—(Fig. 72). These saws are made, too, for cutting many other materials, such as stone, ivory, cork, candy, rubber, etc., etc.

In both these classes the range of sizes is great: the wood-cutting saws vary from 1 inch in diameter to the imposing Circular Saw up to 110 inches in diameter for the sawing of big timber.

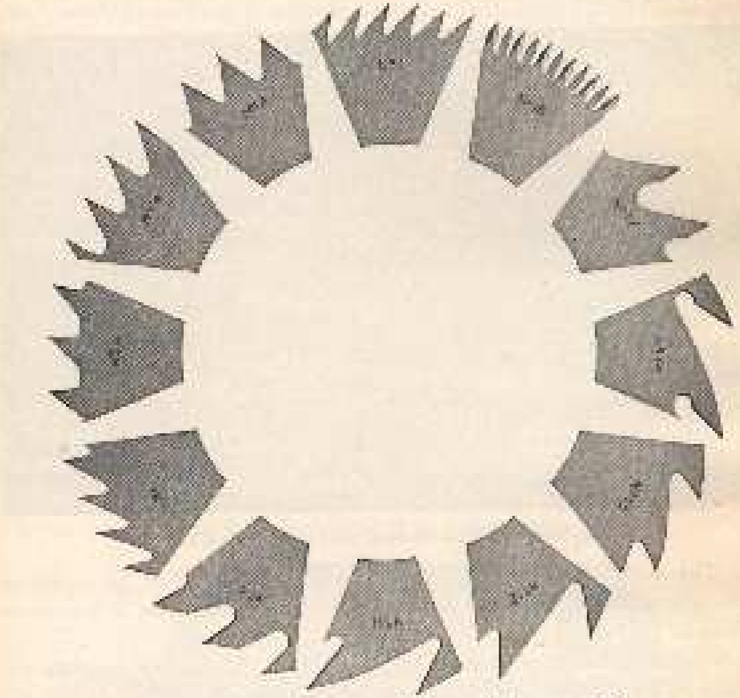


Fig. 73.—Standard sections of Disston circular saw teeth.

In the front rank, by reason of their size and more general use, are the large Gullet Tooth Saws (originated and patented by Henry Disston) used in cutting logs into lumber.

Reference to Fig. 73 will show some of the general styles of teeth with which solid tooth Circular Saws are equipped. Each one of these is adapted to some special kind of work—ripping or cross-cutting, hard-or softwood being formed to produce the best and greatest results under proper conditions.

Circular Mitre Saws are a smaller type of the thin-bladed Circular Saw, ranging in size from 4 inches to 2 feet in diameter. These have special shaped teeth. They are taper ground for clearance, therefore run without set. Such saws are used in cabinet and cigar box work where a smooth, clean cut is desired. (See Fig. 74.)

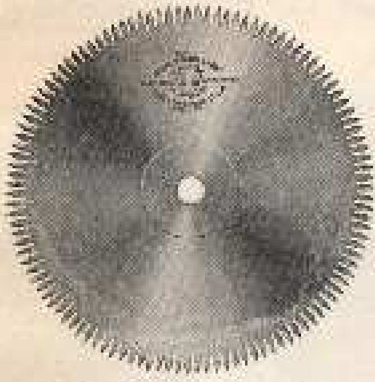


Fig. 74.—Mitre tooth circular saw.

Fig. 75.—Grooving saw.

The Combination Circular Saw: This saw is fitted with "cleaner" teeth at intervals for faster cutting. These saws both rip and cross-cut.

Grooving Saws, as the name indicates, are designed for cutting grooves of various widths and depths. Many styles of special teeth are made in these saws according to the size and shape of groove desired. (See Fig. 75.)

The three last mentioned saws are usually ground thinner at the center than at the edge and require no set.

It was formerly the general practice to tongue and groove boards on a machine which had a single groover mounted on one end of the arbor, and three Grooving Saws set close together on the other end. The board was passed edgewise over the single groover, to cut the channel, then turned and passed on its opposite edge over the three saws, the middle one of which, being of smaller diameter, planed the edge of the tongue.

This method is in general use in shops and small mills, but where large quantities of tongue and groove boards are made in stock sizes the work is done with matcher bits.

A peculiar variation of the Grooving Saw (see Figure 182 on page 183) is the Dado Head Saw, which consists of outside and inside cutters. This style saw will cut from 1/8" to any width desired by the addition of more inside cutters. A glance at the illustration will show the make-up of this composite Grooving Saw.

A new type of grooving saw (see illustration Fig. 183) has recently been patented by Henry Disston & Sons, Inc. This saw consists essentially of a circular steel plate so designed that teeth of various sizes and shapes can be readily fixed in it. Almost any type of standard groove can be cut by this one saw at one operation, depending on the shape and adjustment of the teeth.

Fig. 76.—One hundred and ten inch circular saws for Western logging.

Only a few of the circular saws now in general use have been described. There is a great number on the market today, each type being designed for some specific purpose.

It is interesting to note that the Disston Works made the two largest Circular Saws in the world. They were of the Spiral Inserted Tooth type, and measured 110 inches in diameter, shown in Fig. 76. Each saw contains 190 teeth. These saws were started from ingots weighing 1140 pounds. After reheating, rolling and trimming, the remaining weight was 675 pounds.

They were sent to the Pacific Coast, where they are used for cutting shingle bolts from large trees in that section.

Special machinery is necessary to carry them. To fully appreciate one of these immense saws, one must see it in action. The humming of the saw, starting with a low note, increases as the speed, until at full speed it has attained a high pitch. The serrated edge travels at a speed of about 130 miles an hour and cuts through the big logs with ease.

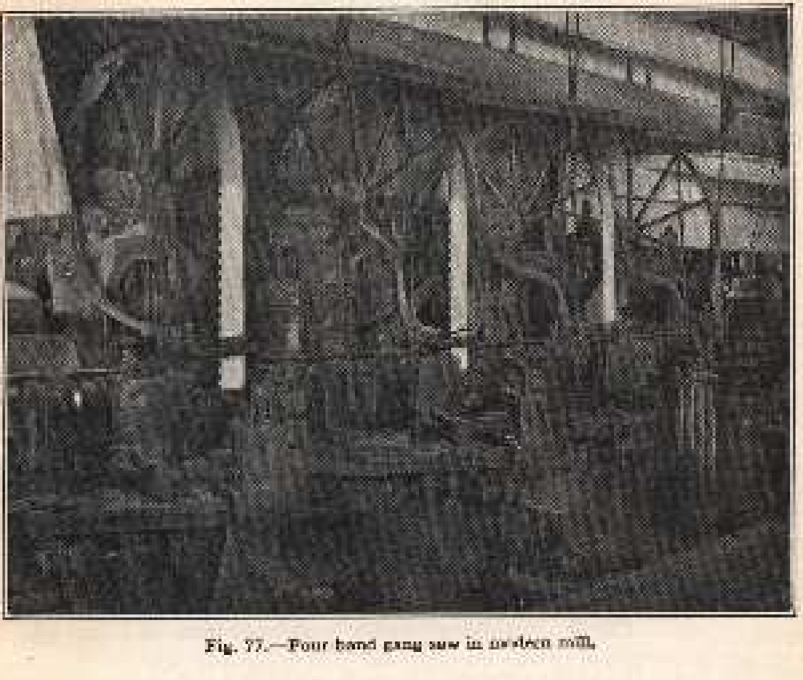


Fig. 77.—Four band gang saw in modern mill.

CHAPTER VII

Files

A FILE is a strip of hardened steel, with evenly spaced teeth cut or upset on its surface, in such a manner that when held in contact with and pushed over materials less hard than itself, it will cut away their surface.

Section A

How a File Cuts

Consideration of the cross-section of a single-cut file tooth, as shown in Fig. 78, discloses that it is essentially similar to a saw tooth with its front nearly vertical to the face of the file. As the tooth extends across the entire face of the file, its cutting action is more exactly comparable to a skew chisel held at a steep angle to the engaged surface. The shape

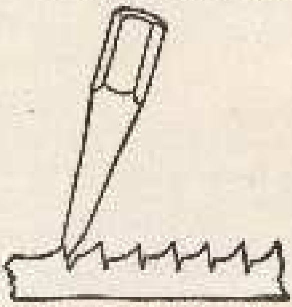


Fig. 78.—Showing angle of chisel in cutting file teeth.

of the teeth, the space between the teeth, and the force applied to the file determine the amount of material removed by each tooth at each thrust. The fact that the teeth are cut diagonally across the face of the file aids the carrying off of the chips and assists further the shearing or knife action against each particle of metal cut.

In double-cut files the first or "overcut" is similar to that on single-cut files and cut at about the same angle. The second or "upcut" is at more nearly a right angle across the face of the file. (See Fig. 79.) This

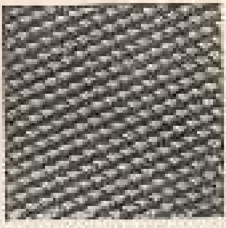


Fig. 79.—Rough cut of double-cut file.

second cut changes the surface of the file from a series of chisel edges to a surface of diamond pointed cutters. If you look down the face of a double-cut file you will note that the cutting points are not in lines parallel to the length of the file, but run at a slight angle.

Section B

How to Use a File

The file properly handled is pushed or thrust over the surface being worked, but since there is no groove formed, as in a saw's action, it becomes necessary to both guide its direction and hold it in contact with the surface as shown in Fig. 80. These actions can be analyzed:

1. Pushing the file over the work with the right hand, thumb on top of handle, end of handle resting in socket of palm.

2. Guiding the point of the file with the left hand, thumb on top of the end of file, or with socket of hand holding end of file.

3. Slightly raising the file from the work during the return stroke, to prevent dulling of the teeth.

4. Adjusting the height of the work and the motion of the file so that it travels in the same horizontal plane during the full stroke forward.

5. Exerting sufficient pressure through both hands so as to keep the file engaged on the work during the forward or cutting stroke.

Correct holding is essential to assure the greatest length of stroke and the maintenance of the right path for the file. Proper height of work in the vise is slightly below the operator's elbow as he stands at the bench, so that he files with full motion of the arm rather than by moving only wrist and elbow. Of course, light, fine work should be raised nearer the operator's eyes and very heavy work placed on a lower level to allow the

Fig. 83.—Using a file for fast cutting.

workman to get the force of his entire body back of the stroke if necessary. The position of the filer should be easy and natural.

The work should be clamped to assure rigidity and avoid chattering. Rocking or pitching indicate improper stroke, and cause the surface to be arched rather than flat. "Riding" the file or exerting undue pressure further adds to this arching and also means that the file will remove material so rapidly that it will "choke." If faster cutting is desired, it is better to select a coarser file than to "ride" the one in use. Perhaps the user is taking short, quick strokes, thus using but a few inches of the filing surface, when a complete slower motion would accomplish more and maintain a flat surface.

Where it is necessary to hold the file in one hand, as in cleaning contact points, sharpening small cutting tools, etc., the forefinger is usually extended along the back of the file while the handle is grasped normally. This position gives effective one-hand control.

While the directions given thus far have referred more in particular to flat surface work, there is considerable work on curved surfaces, the unlimited variety of which precludes more than the suggestion that care be used to select the right length, shape, and cut of file for the work; that the filing be done so that the surface will be a continuous curve rather than a series of small areas that have been filed individually and do not join to form an even, curved surface.

Section C

Care of Files

1. Do not throw a file into a drawer or on a bench. Lay it down or, better, provide a rack for all files and replace them in the rack. To do their work effectively files must be made as hard as fire and water can make them, consequently the teeth may be chipped by rough handling.

2. If the file is not cutting, because it has been "ridden" until its gullets (the spaces between the teeth) are choked, it should be "carded." A card is a wire brush to run across the face of the file to loosen the embedded filings. There is also a fibre bristle brush made to remove the material so loosened. The Disston File Card and Brush shown in Fig. 230 combines these two in one and is convenient and effective. Never tap the file on the vise to clear its gullets of loosened material, this may break the teeth. Use a file card and brush.

3. In placing a handle on the tang of a file, do not hit the end of the file to drive it into the handle. Push the handle on and, holding the point of the file up, tap the butt end of the handle on the bench to drive the tang into place.

4. Never use a file to pry or hammer.

5. Do not exert undue pressure while filing, but keep the file engaged in the cut to avoid glazing, which destroys the keenness of the teeth. Never allow a file to slip over the work; this dulls the teeth.

6. Be sure to slightly raise the file during the return stroke, in order to clear the work and prevent dulling by wearing away the back of the teeth, thus destroying the cutting edges.

7. Be sure that the material to be filed is securely fastened in a suitable vise. Loose work permits the file to chatter, which also quickly destroys the edge of the teeth.

8. Have sufficient variety of files available to permit selecting the right length, shape, and cut for the work to be done.

Section D

How Files are Named

There is much confusion, both in schools and in industry, regarding the basis on which files are named. Three details must be specified to describe a file correctly. These are length, shape, and cut.

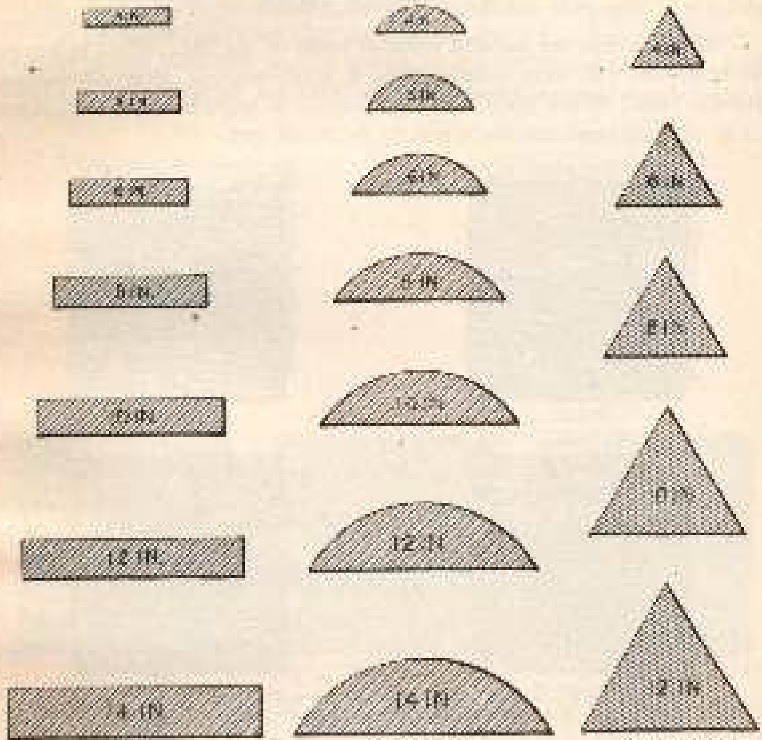
1. Length

Files are designated as so many inches long, but this does not include the length of the tang. The length is measured, therefore, by the distance from the "shoulder" or curve, where the tang starts, to the point. The usual sizes for school shops are 4, 5, 6, 7, 8, 10, 12, and 14". The two other dimensions of files, namely, their width and thickness, are proportional to the variations in length. For example, a 4" flat file is $\frac{7}{16}$" wide and $\frac{3}{32}$" thick, while a 6" flat file is $\frac{5}{8}$" wide and $\frac{5}{32}$" thick. Figure 81 shows comparative cross-sections of mill, half round, and three square files in lengths from 4 to 14".

2. Shape

Files are classified according to their general shape. In cross-section they may be rectangular, round, square, half round, triangular, diamond shaped, or even oval. In outline they may have parallel edges (termed blunt), converge in straight or curved lines to a point, or taper slightly through the latter half of their length to a somewhat smaller width at their point. Files also taper in thickness as they taper in width.

The most striking feature of its shape often gives a file its name. Referring to their cross-section we have the square, round, half-round, three square (triangular), flat, cant, feather edge, and knife files. In other cases the names suggest the purpose or place of use, as mill, slotting, slitting, auger bit, chisel point, drill, lock, band-saw, square gulleting,



Mill. Half round. Three square.

Fig. 81.—Actual cross-sections of files for lengths indicated.

topping, warding, machine, etc. In a few cases the names of files are trade derivations, as Hunt's Chrome, Climax, Perfection, and Shear Tooth, etc.

In at least one case the outline suggests the name, as in the taper file, used in filing saws. This file looks like the three square file, but the edges are rounded to shape the gullets of the saw. Taper files are single cut, while three square files are double cut. It is well to keep in mind that all files have some designation to indicate their shape and that this must be given to get the type of file desired. (For illustrations of the shapes of files most commonly used in school shops see pages 197 to 204.)

3. Kind of Teeth

Cut refers to the parallel series of teeth on the file. What is known as single-cut files have parallel lines of teeth running diagonally across the file face. When there is a double series of teeth crossing each other at an oblique angle the file is said to be double cut.

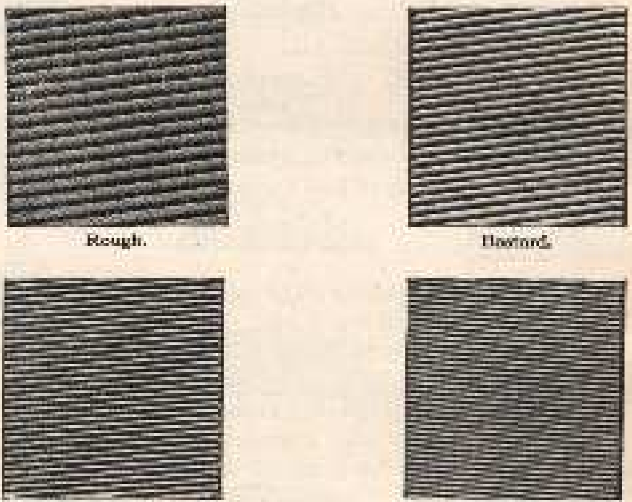


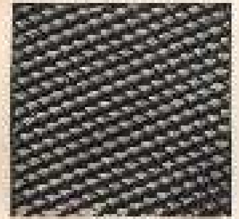
Fig. 52.—Four main graduations of single-cut files (12 inch size).

Single-cut files have a series of chisel edges, while double-cut files have a staggered number of cutting points. The double-cut files are more like rasps where each tooth is pushed up from the blank by a special cutter. The type of cut for any given shape of file is well defined, and, in general, it is not necessary when ordering standard files to state whether single or double cut is wanted. For example, single-cut files: mill, taper, band saw, climax, round (up to 8"), topping, cant, and, in fact, all saw files.

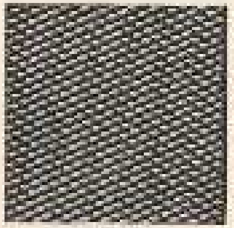
Double-cut files: flat, hand, half round, round (8" and over), three square, knife, arch, equalling, pillar, slotting.

4. Cut

In speaking of files, by "Cut" is meant, not whether the file has single or double series of teeth, **but the spacing between the teeth.** This is a difference of terms that it is important to remember. In designating the cut of files, that is, files having coarse or fine teeth, certain arbitrarily assigned names are used, such as rough, bastard, second cut, or smooth.



Rough.



Bastard.

Second cut.

Smooth.

Dead smooth.

Fig. 83.—Five main graduations of double-cut files (12 inch size).

Figure 82 shows the four usual single-cut teeth spacings, i. e., rough, bastard, second cut, and smooth.

Figure 83 shows the usual double-cut teeth spacing, i. e., rough, bastard, second cut, smooth, and dead smooth.

Figure 84 shows the usual rasp cuts, i. e., rough, bastard, second cut, and smooth.

These illustrations are of a flat-faced file 12" in length. For a file of any length other than 12", the number of teeth per inch will be pro-

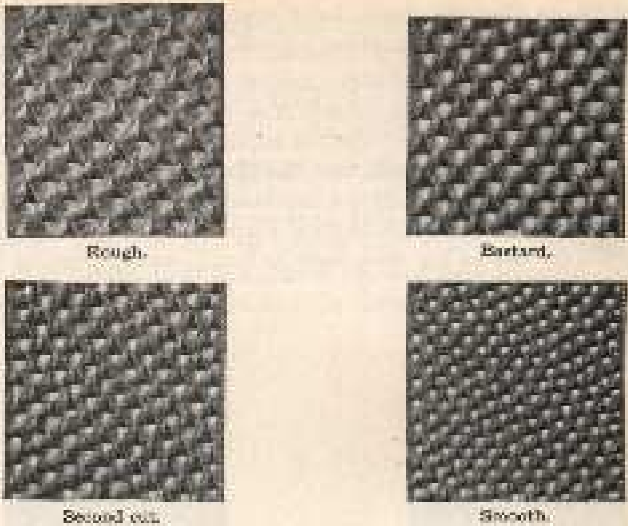


Fig. 84.—Four main graduations of rasps (12 inch size).

portional to its length compared to the 12" file. For instance, a bastard cut on a 6" flat file will have 38 teeth per inch, which shows by comparison that it is about the same fineness as a 12" smooth in the illustration. Thus it is seen that in ordering it is very important to give the cut desired.

Section E

How to Order a File

The following chart shows the three details that always must be given in ordering files:

SINGLE-CUT FILES

1. Shape	2. Usual Spacing of Cut	3. Usual Sizes
Mill	Bastard, Second Cut, or Smooth	6, 7, 8, 10, 12
Taper	Second Cut	4, 5, 5½, 6, 7, 8
Cant	Second Cut	6, 7, 8, 10
Round	Bastard, Second Cut, or Smooth	4, 5, 6, 6½, 7, 8
All other saw files	Second Cut	4, 5, 6, 6½, 7, 8

DOUBLE-CUT FILES

1. Shape	2. Usual Spacing of Cut	3. Usual Sizes
Flat	Bastard, Second Cut, or Smooth	4, 5
Hand	Bastard, Second Cut, or Smooth	6, 7, 8, 9, 10 12, 14, 16, 18
Half-round	Bastard, Second Cut, or Smooth	
Pillar	Bastard, Second Cut, or Smooth	
Round	Bastard, Second Cut, or Smooth	

RASPS

1. Shape	2. Usual Spacing of Cut	3. Usual Sizes
Flat Wood	Bastard, or Second Cut	8, 10, 12, 14
Cabinet	Second Cut, or Smooth	6, 8, 10, 12
Half-round Wood	Bastard, Second Cut, or Smooth	6, 8, 10, 12, 14
Round	Second Cut	6, 8, 10, 12, 14

Be sure in ordering a file to give three details: (1) shape, (2) cut, (3) length.

For example:

(1) Flat, (2) Bastard, (3) 8-inch.
(1) Mill, (2) Second Cut, (3) 10-inch.

Section F

Superfine Files

Under the heading of superfine files are many varieties—all having extremely fine teeth—ranging from the tiny files used by watch-makers and jewelers (some of which have teeth so fine that the files feel smooth to the hand) to the larger files used mostly for finishing work by tool-makers.

Excepting in those cases where they are included in machine shop equipment, superfine files are not much used in school shops.

These files have teeth from about 40 to the inch to as high as 200 teeth per inch. These different cuts are designated by numbers which indicate the fineness of cut. These numbers are 00, 0, 1, 2, 3, 4, 5, 6, 7, and 8. Number 00 is the coarsest.

These files are specified just as are regular files—by (1) shape (some of the most used of which are hand, flat, pillar, barrette, slitting, warding, knife, etc.), (2) cut (explained above), and (3) length (varying from 2½ to 14 inches).

CHAPTER VIII

History of the File

Section A

Early History

AS IN many other things, nature herself has shown the way to man in the development of files. There is a type of mollusc having a rough tongue with which it rubs or files through the shells of other molluscs on which it feeds. The wasp, also, has a rasp-like organ with which it abrades dry wood, afterwards mixing the dust with a glutinous saliva to form the paper from which it builds its hive. The cat's tongue and that of the cow are familiar examples of abrading organs in the animal kingdom.

To abrade, or file, ancient man used sand, grit, coral, bone, fish skin, and gritty woods, also stone of varying hardness in connection with sand and water.

Crude as were these abrading instruments, and slow and laborious as must have been their use, they nevertheless served primeval man well throughout the Stone and Bronze Ages. Up to the time of the discovery of iron natural abrasives were used extensively. Copper and, later, bronze did not permit of sufficient hardening to be used as a material for the making of artificial files, although attempts were made to use both for that purpose.

Strange as it may seem, the North American continent has yielded more examples of the natural files of the ancients than any other part of the globe. Among the Mound Builders and Cliff Dwellers of America, those ancient and prehistoric peoples of whose coming and going so little is known, stones were used for abrading purposes. Although both races left traces of their familiarity with certain kinds of metal, from which they made tools, ornaments, and other articles, neither race apparently was acquainted with the artificial file. Nothing of the kind has ever been found, so far as is known, but several examples of the stone file have been unearthed.

Figure 85 shows one of these stones which was found in a Mound Builders cemetery in Tennessee. From the peculiar grooves in this stone it would appear that it had been used for smoothing arrow shafts.

Fig. 85.—Filing stone used by Mound Builders in Tennessee.

Early Indians Used Abrasive Tools.—The ancient Pueblo Indians, who inhabited the Calistoo Basin in Western North America, left, among many other crude tools and pieces of pottery, specimens of stone which archaeologists say were also used to smooth and polish arrow shafts. Some of these are preserved in the American Museum of Natural History

Fig. 86.—Stones used by ancient Pueblo Indians for polishing and straightening arrow shafts

in New York. An example of these stones is shown in Fig. 86. The material appears to be soft sandstone, of varying grades of fineness, in which deep grooves have been worn by drawing them along the wooden shafts. As proof of this use, it may be said that Eskimos of the Arctic regions today use stones to smooth and sharpen their spear-heads. Captain George Comer while on an expedition in the far north secured a specimen of stone, pictured in Fig. 87, which was used as a file by the natives. It

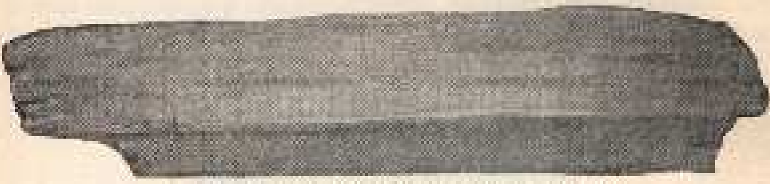


Fig. 87.—Stone used as a file by Netchillik Eskimos.

measures about 8 inches in length, 1¼ inches in width, and ½ inch in thickness.

In spite of a civilization claimed to antedate that of the East, the development on the Western Hemisphere in ancient times did not seem to

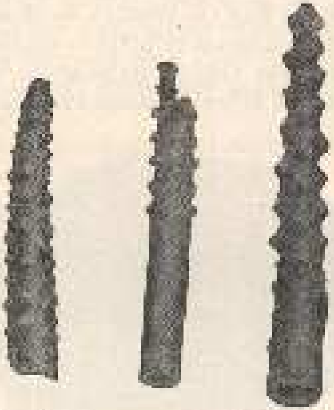


Fig. 88.—Bronze rasps used by Egyptians 1200 B. C.

go beyond a certain point. So, while we find early specimens of the file on the American continent, we must turn to the Eastern countries for the beginning of what we have termed the artificial file.

It is sometimes difficult to place the dates or ages of many stone and metal implements found among the ancient remains, for Europe remained far behind Asia in this particular for many years. In 2500 B. C., while all Asia shared in the knowledge of Bronze, Europe was still in the Stone Age. Then, too, long after metal was fairly well known and used, many still clung to their stone tools. This is believed to have been especially so with the poorer classes who could not afford the more costly metal implements. Indeed, it is well known that in the mines of Spain and Sardinia stone hammers were in use during historic times.

Of prehistoric files recovered, the greater number have been of bronze from the "hoards" of that period. A "hoard" is a deposit or collection of bronze objects. Investigators have found them in many places all over

Fig. 89.—Indian rasp used in making arrow shafts.

Europe—several ancient cemeteries appearing to have been favorite hiding places.

Among the earliest known examples of the artificially made abrading instruments of metal, for which a date can be fixed, is a bronze file which was dug up in Crete by an expedition from the University of Pennsylvania, and is now in the Museum at Candia. This file has a rounded back and a flat surface for rubbing. Though it possesses an astonishing likeness to the half-round file of today, this prehistoric file is believed to have been made about 1500 B. C. Its length is 3¾ inches; width, ½ inch, and thickness, ¼ inch.

Rasps Used 1200 Years B. C.—The Egyptians of the Eight Dynasty, about 1200 to 1000 B. C., made small rasps of bronze, as several specimens have been found which could be more or less accurately connected with that time.

These rasps are shown in Fig. 88. They are 1½ to 2½ inches in length, and appear to have been made from sheet bronze. Holes were punched through the metal with a sharp-pointed instrument. It was then coiled into the form of a cone-shaped cylinder with the rough edges or projections of the holes on the outside. These acted as the teeth. It is uncertain what these crude rasps were used for. The softness of the material must have made their use extremely limited.

First Iron Rasps Made by Assyrians. The Assyrians, who were about the first race to profit by the discovery of iron, made a straight rasp of iron of which an excellent example has been found, the form of which is exactly like that of modern times. As this rasp definitely dates back to the seventh century, B. C., it will be seen how clever the ancients were in originating tools which have preserved their essential form down to the present day.

Roman files that have been found at Alis, Halstatt, and Come-Chaudron, particularly those found at Halstatt, are of especial interest, as they show one of the earlier methods of producing the teeth. (See Figs. 90 and 91.) That is, in some of the early files, the teeth themselves were

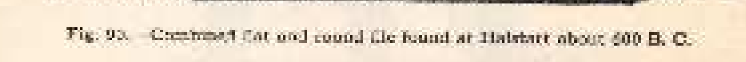


Fig. 90. —Combined flat and round file found at Halstatt about 600 B. C.

Fig. 91. File found among Roman remains at Silchester, 300 A. D.

formed by filing. The files mentioned above gave every evidence of having been used for this purpose. The filing of the teeth, however, seems soon to have been replaced entirely by cutting. A chisel made of good steel made it possible to manufacture the file much quicker than by the filing method.

Early Uses of Files.—In Fig. 89 is shown a rasp used by the American Indians in making arrow shafts, etc. This rasp, which is in the Museum of the University of Pennsylvania, was obtained from the Indians in 1908. It had been in use for a considerable period. The rasp is made of a piece of sheet iron with holes punched through. The sheet was then bent over like a book cover, with the rough edges of the holes on the inside. The article to be filed was run through the interior. The use of sheet iron has only been known to the Indians for about eighty or ninety years, so it will be seen that this rasp is quite modern.

The Indians of later times made a blow gun out of a species of cane which much resembled bamboo. To clear this out and smooth the joints they had a special form of rasp (see Fig. 92) mounted on a long thin stick. This rasp, too, was made by punching holes in a piece of metal with a

Fig. 92.—Indian rasp for boring out cane.

sharp instrument, and then coiling the tin in a conical form somewhat similar to the rasps of the ancient Egyptians. As the Indians could have no knowledge of the methods used by the Egyptians several thousand years before, the similarity in these rasps is striking.

While slight mention is made of files in medieval times—when they must have seen their first great development—we know that much of the iron and steel work turned out could not have been accomplished without the aid of files.

During the Middle Ages St. Dunstan, a monk born in Glastonbury, England, who is considered the patron of the blacksmith, produced many wonderful things, and greatly aided in the improvement of metal tools. While there is no record to that effect, the nature of his work would imply that the file received some benefit from his extraordinary genius. He died in 988.

Monk Wrote Book on File Making.—Another Monk, Theophilus Presbyter, of the Benedictine Cloister, Helmeshausen, gave to the world several formulae for tempering iron instruments. He also wrote a very interesting description of file making in Germany about the end of the eleventh century. Among the simpler forms of files which he mentions are those made of soft iron, which were afterward hardened. After the file had been forged to the desired form it was made smooth by a plane and then provided with grooves and teeth. He describes the hardening process very clearly, and, curiously enough, it does not differ greatly from some present-day methods.

The men who worked in iron, and were the chief users of such tools as files, had become at this time the most important of the artisans. A guild of blacksmiths was formed in Florence in the thirteenth century, while in England the guilds of the blacksmiths were started in 1434. It is only natural to suppose that these men did much to develop the efficiency of the file in the course of their daily work.

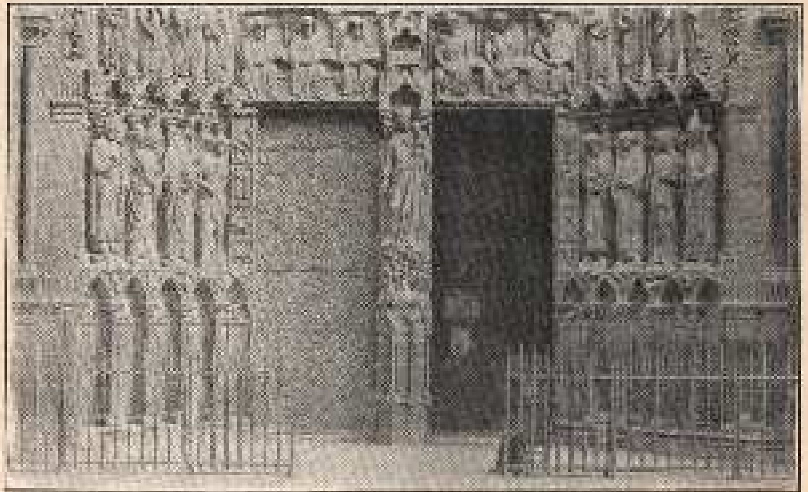


Fig. 93.—Wrought iron door of Notre Dame Cathedral.

The earliest point at which a definite thread in its history can be regained is when the Notre Dame Cathedral was built in Paris in the thirteenth century. A smith named Biscornette was employed to decorate the doors of the great cathedral with iron work (see Fig. 93). He performed this work, which was wonderful in its beautiful effects, secretly, by a process known only to himself. Bits of this iron were broken off at various times by people who wanted to discover how the work was done. Numerous theories were advanced, one of which affirms that the iron was cast, "and then treated with a file." This shows that the file at that time was becoming a necessary part of the smith's equipment. It proves, too, that it must have reached a very high state of perfection to have enabled a man to do such fine work in metal.

It was not until the fourteenth century, however, that those who practised art in iron work began to use other tools, besides heat and the hammer, regularly.

We read that "file and saw, vise and drill were called to his (the smith's) aid."

The use of these tools gave greater command over the metal as well as better result in the work. This, too, would tend to show a steady improvement in the file, rendering it more applicable to heavy work in metal.

Medieval Europe and File Making.—In the middle of the fifteenth century Nuremberg was the foremost place of production of files, but when the Thirty Years' War paralyzed the industry of Germany, Sheffield, England became the center of file manufacturing. Tradition says that from the earliest times the manufacture of files has been carried on in Sheffield. No doubt this is true, because we know that Sheffield held front rank in the manufacture of tools for hundreds of years. However, there is a record which states that the first file was made there in 1618.

File Cutters Among the Colonists. In America, during the days of the early colonies, most of the files that might be required were imported from abroad, though a few artisans who had learned the trade in their mother countries may have produced some for local use. It is claimed that in 1698 there were in Philadelphia "artificers of many kinds, among them cutlers, gunsmiths, locksmiths, nailers, and file-cutters." The records also show that a concern named Broadmeadow & Company was making files in a small way at their factory in Pittsburgh, Pa., about 1829. With this exception, prior to 1840 the manufacture of files was practically unknown in the United States.

About 1845 the making of files on a small scale was begun at Matteawan, N. Y., by John Rothery, an Englishman. It is reported that he made excellent files, and his success induced others to enter into the business of making files. From that time the manufacture of files took a firm foothold in this country, but until about 1864, Europe continued to supply the greater number of files used in America. It was a long uphill fight for the American file manufacturer, for most of the mechanics had come from abroad and were naturally prejudiced in favor of the files they had learned to use at home.

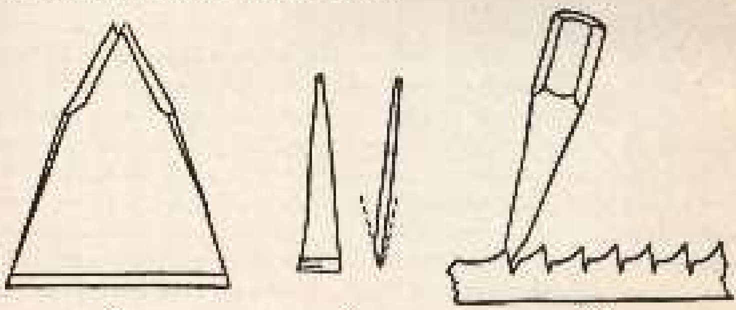
Section B

Making the Modern File

The manufacture of files, until comparatively recent times, was done entirely by hand. Just what methods the ancients pursued in making their files it is hard to say, but they must have followed similar methods to those in vogue up to about sixty years ago.

In cutting files by hand the necessary tools are so simple, that, without doubt, those in use in the later days of the art were similar to those the hand cutters of past generations must have used.

Preparing the File Blank.—In preparing the file blanks for cutting by hand the early stages were much the same as today. The blanks were forged to shape out of bars of steel that had previously been rolled. The forged blanks were then annealed to make them more susceptible to the cutting edge of the hard steel chisel.



A B C

Fig. 94.—A. Chisel for handcutting large, rough files; B. chisel for cutting small, fine files; C. action of chisel in upsetting teeth.

After the annealing process the surfaces of the blanks were cleaned and leveled so that the entire surface was accurate. This was done by grinding and filing. The usual practice being to file the small blanks and grind the large ones.

Then the blank was slightly oiled to allow the chisel to slip over it easily. It was then ready for the file cutter. This man was seated before a square iron anvil, usually solidly mounted on a heavy stone base. Provided with blocks of lead having appropriate grooves to fit files of various forms, he selected the one required and placed it on the anvil, adjusted the file blank in the groove, with the tang toward him. To hold the blank in place while being cut leather straps were used. These passed over each end of the file, and the ends were held down by the workman's foot.

The cutter selected a chisel suitable for the cuts to be made. (See Fig. 94, A and B.) Then with a hammer and this chisel he cut the teeth in the blank by a rapid succession of blows, each time removing the chisel a slight, but regular distance, toward himself. The workman was aided in gauging this distance by the slight ridge or burr raised in advance of the tooth being cut, at each blow of the chisel. This is shown quite clearly in Fig. 94, C. For each new tooth the chisel was slid until it met this ridge, when it was ready for the next cut.

The chisel, held at an angle, cut the groove and at the same time raised one edge of the metal, thus forming the tooth.

Fig. 95.—Hammer used to cut files by hand.

The hammers used in the file cutting were of peculiar shape and some weighed as much as six pounds. This caused great bodily exertion, which, in conjunction with the constrained position of the file cutter over the anvil, was very injurious to health. All this has been done away with by the use of machines.

Hand-made files were produced with an astonishing degree of dexterity which was only to be acquired by long practice. The burrs cut on a file with a sharp-edged chisel were produced at the rate of 150 to 200 per minute. While traced by the sense of touch alone, the lines were nearly as straight as though cut by a machine.

Cutting Files by Machine. As stated, the file cutters themselves were mainly responsible for the final adoption of machinery in the manufacture of files.

While it was not until about 1860 that file-cutting machines began to be used, though the efforts of inventors had been directed toward the perfection of a suitable machine for several centuries, it is a well-known fact that the ancients showed remarkable mechanical genius and produced the basic ideas for many modern tools and machines. Yet there is nothing in history to show that they ever dreamed of cutting the file in any other way than by hand. The first authentic record of a machine for the cutting of files has been obtained from a manuscript left by the great Italian painter, Leonardo de Vinci, who was also famous as an engineer. In 1502 he was appointed chief engineer and architect of the Ludovico il Moro Duke of Milan's army, and it was during this service that he conceived the idea of a file-cutting machine. Figure 96 shows a reproduction from his drawing of his machine which he invented some time before 1505.

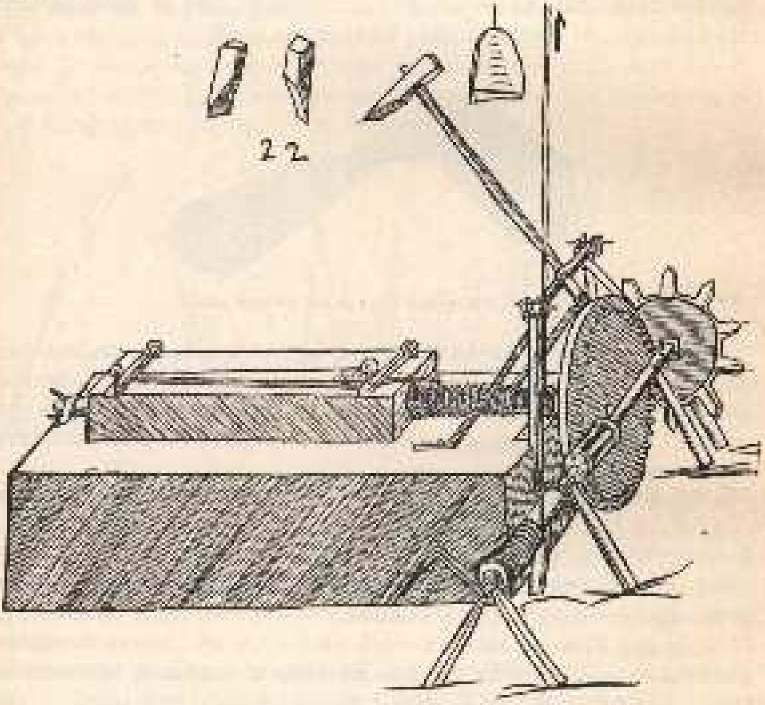


Fig. 96. Leonardo de Vinci's invention for cutting files, 1505 A. D.

An examination of this drawing shows that all parts of the machine have been carefully provided, and it is complete in all details. According to his description, he intended to make the machine independent of crank and man-power. A weight and rope set the main shaft in motion. The length of rope and height of weight (giving length of ultimate downward travel) to be according to the length of file to be cut.

This device shows his wonderful inventive capacity and mechanical skill, since even sixty years ago we had not advanced much further than the design here shown.

The first really practicable machine was that invented by E. Bernot, of Paris. This machine, which is shown in Fig. 97, was used to some extent with success in France and Belgium, and about 1860 was introduced into Great Britain. It was patented in the United States, July 24, 1860, and later was brought into the country.

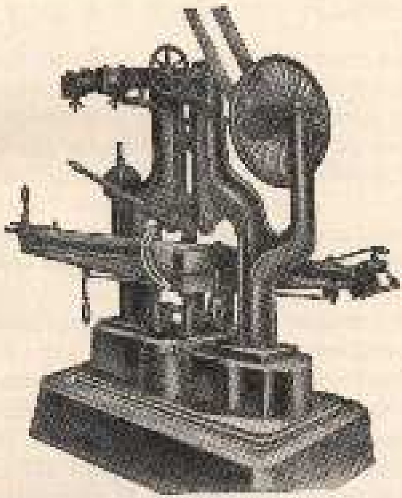


Fig. 97.—First practical file-cutting machine. Invented by E. Bernot.

In 1862 M. D. Whipple, of Cambridge, Mass., made a number of improvements for file-cutting machines, but the biggest step forward was when, in the same year, some enterprising capitalists in Baltimore secured the right to make and use Bernot's file-cutting machine in this country. Nine of these machines were built with slight modifications and set up in Pawtucket, R. I., where they were run with great success.

On January 16 and June 13, in 1864, patents were again issued to Morris B. Belknapp, of Greenfield, Mass., for a new machine for cutting files and sickles. This machine cut from five to six dozen 12-inch files daily. On April 11th, of this same year patents were also issued to Charles Hesser and Amos Paxson, of Philadelphia, as well as to William T. James, of Greenwich, N. Y., for file-cutting machines.

As has been shown in the foregoing history of the file, many of the present forms of the file were substantially originated in the earliest days of its history. These have been modified and added to as the knowledge of file manufacture increased, and as new and different uses were discovered. The result is that at the present time the file is probably made in more varieties than any other type of tool.

CHAPTER IX

Machine Knives

Section A

Types of Machine Knives

FOR THE purpose of this text, we will consider a machine knife as any knife used in a machine, either hand or power driven. Machine knives are important factors in many industrial processes. In the forming of wood alone, machine knives are used for such essential processes as planing, jointing, moulding, rabbeting, beading, fluting, grooving, trimming, chamfering, tenoning, veneering, etc.

Composition of Machine Knives.—Machine knives can be divided into the carbon steel and the high speed steel types, depending on their composition.

The carbon steel knives are of different tempers, and this variation separates them into the high, high medium, medium, and sometimes the low medium tempers. Carbon steel knives of high temper must be sharpened by grinding on an abrasive wheel. Those of high medium temper are usually ground, but can be slightly dressed by a mill or a planer knife file. The medium and low medium temper knife can be filed without difficulty while the knife is still in the head of the machine.

Knives of high-speed steel are always sharpened by grinding.

Types of Machine Knives.—Knives are further classified as thick or thin. The thick knives are used in slotted heads, as will be explained later. Thin knives, usually from ⅛" to 5/32" thick, are either carbon steel or high-speed steel, the latter being recognizable by its finer texture and greater weight, and also by the fact that the high-speed steel, when being ground, gives off dull red sparks that are not seen when grinding carbon steel knives. So-called thick knives which range from ¼" to ⅜" thick, are made in three ways, first, entirely of high carbon crucible steel (usually this type is limited to blades of short length); second, with a high carbon crucible steel cutting face cast or welded on a lower carbon steel back; and third, with high-speed steel cutting face brazed into a notch on a low carbon steel back. The actual construction of these "faced" blades is better understood after examining Fig. 98.

Fig. 98.—Cross-section of Disston welded machine knife with high-speed steel face.

What Knife to Use.—The following will give an idea of the most suitable knives for kind of wood being planed:

High tempered carbon steel knife.	All hardwoods, as kiln dried maple, birch, beech, oak, yellow pine, rosewood, locust.
High medium tempered carbon steel knife.	Close grained woods: Bass, walnut, elm, ash, mahogany, cypress.
Medium tempered and low medium carbon steel knife.	The soft woods: White pine, chestnut, cedar, gum, balsam.
High-speed steel knife—	Gives longer wear and more service for each grinding in any kind of cutting.

Although planer knives follow in hardness the wood being cut, most millmen prefer their shaper knives and lathe knives to be very hard, unless these edges contain curves that are impossible to reach with the grinding wheel, in which case the knife should be of a temper that can be sharpened by a file.

Section B

Information on Bevel

Degree of Bevel. The bevel of the cutting edge is an important consideration on machine knives. This bevel is from 30 to 42 degrees on both thick and thin knives; that is, the faces of the knife make an acute angle of this range at the bevel point. This angle, of course, is reduced if the knife is filed while in the head. Some machine knives are run somewhat flat; that is, with as high as 42 degrees between the beveled and the back edges. It is sometimes set forth by millmen that a thin edge as low as 24 degrees bevel will tear out small knots and raise the grain of the wood. White pine will stand a thin bevel if it is the

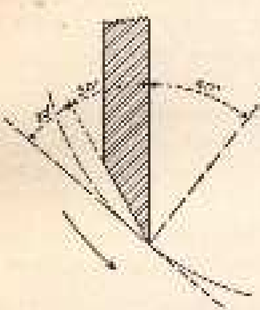


Fig. 99.—Cutting angle of carbon machine knife.

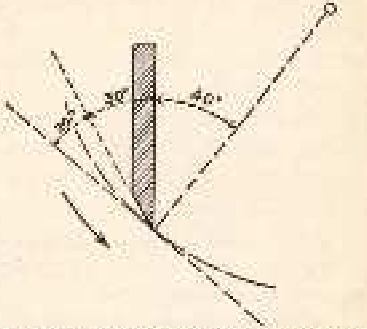


Fig. 100.—Cutting angle of high-speed steel machine knife.

number one grade, clear of small knots. If it has knots it is better to use a slightly blunter edge. Short bevel requires more frequent sharpening and requires more power, but compensates by giving a smoother finish, other factors being the same.

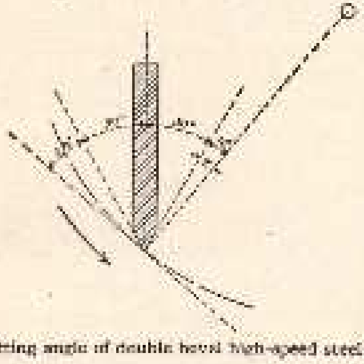


Fig. 101.—Cutting angle of double bevel high-speed steel machine knife.

Double Bevel.—In the sharpening of thin high-speed knives it is the practice with some users to back bevel the edge, which was formerly flat on the back, with a second bevel of from 10 to 30 degrees, so that the knife sets in the head as shown in Fig. 101.

If consideration is given to the way this knife will cut compared to the thick carbon steel knife shown in Fig. 99 or the thin knife shown in Fig. 100, it will be seen that where the single bevel knives cut on entering the wood, they have to tear their way out again, the result being likely to loosen small knots and leave a rough edge. With the beveled face of the thin knife shown in Fig. 101 the thin knife does not dig into the wood, its cutting action being more nearly comparable to that of a wood scraper.

The double bevel is not much used, but occasionally is found in the manufacture of hardwood flooring. As is apparent, the double bevel reduces the cutting action of the knife and produces an action similar to that of a scraper.

With double beveled knives, more power is required, cutting speed is reduced, and, on the other hand, a smoother cut is obtained and a more sturdy cutting-edge on the knife is obtained.

General Rule for Beveling. In general, it can be said that the tendency has been to use a too tapered bevel, thus weakening the cutting edge. Knives have been condemned, when the fault lay in not leaving sufficient metal to stand the strain. A good general rule is that the length of the bevel, measured along the bevel, should be at least twice the width of the knife, giving a 30 or greater degree bevel. For example, a knife ¼" thick should have about ½" bevel.

More important than the exact angle of bevel is the fact that if machines knives were more frequently resharpened the quality of work would be improved and the life of the blade lengthened.

Section C

Types of Cutter Heads

The four-square head is rapidly disappearing due to the introduction of high-speed steel knives and in the quicker adjustment possible with circular type head. On the old four-side head the knives were locked by retaining bolts tapped in the head. This was changed to a grooved notch with a square headed bolt that could be slid along to the points of alignment with the slots in the knife. This is shown in Fig. 102.

Where it is desired to transform the old square-headed type to a high-speed machine, this may be done by ordering the thick knife with high-speed steel cutting face (the Disston "Lock-Weld" knife). A cap can also be put over the knife to make the general outline of the head circular rather than square, as shown in Fig. 103. It is possible, too, to have the square type head replaced with the circular type that permits the use of thin high-speed knives.

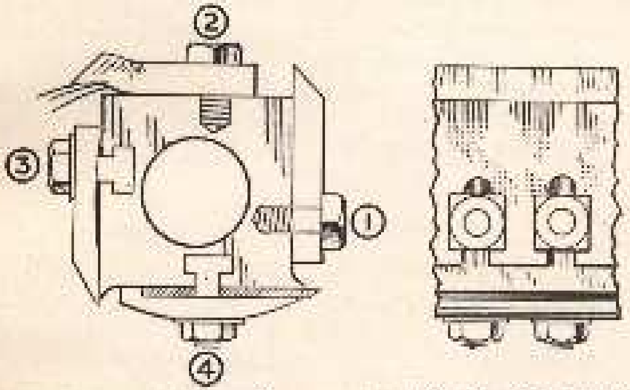


Fig. 102.—1, First method of attaching square head knife; 2, buckling due to flat face; 3, properly attached knife with concave bearing surface; 4, adapting head to thin high-speed knife.

In this connection, however, it is well to quote a well-known manufacturer of woodworking machinery: "We are quite emphatic that the square head should not be made over, but a new head supplied. Usually the square head was designed for a speed less than the round heads

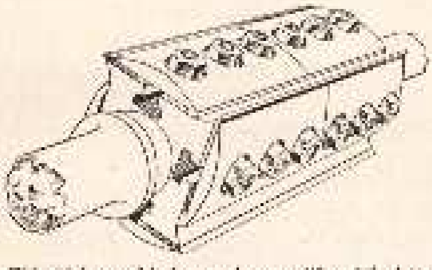


Fig. 103.—Thin high-speed knives and caps with notched square head.

travel, and the extreme delicacy in balancing could hardly be provided by a school to meet these speed requirements. They might better buy a new head from someone specializing in its manufacture."

The circular head, as shown in Fig. 104, has a clamp which presses on the back of the knife, the clamp, in some cases, having a serrated

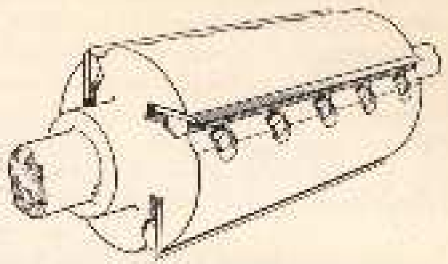


Fig. 104.—Round cylinder head with four thin high-speed knives.

surface which interlocks with a similar surface on the knife. Tap bolts hold the clamp in place. Another type of circular head is shown in

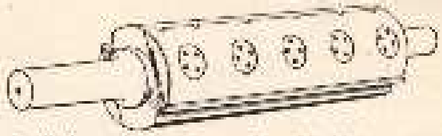


Fig. 105.—Round cylinder and safety cap. Two thin high-speed tool steel knives.

Fig. 105. These types of heads do not require that the knife be notched and are suitable for the use of thin knives.

Section D

Sharpening and Adjusting

Sharpening Machine Knives.—The increasing noise that a machine knife makes during operation, together with the roughness of the planed surface, warn the operator that the knife should be sharpened. Instead of cutting, a dull knife pounds or scrapes the wood and tends to wear out the bearings of the head. In addition, a knife heats in the head and is liable to develop small cracks along its cutting edge if run dull.

Sharpening machine knives is an operation requiring close attention and proper equipment. As an expensive knife can be ruined by improper grinding, it is wise economy to provide proper grinding facilities before undertaking this job. Grinding machines are built with a travelling carriage, which is moved by hand or geared rack, and which permits holding the knife at the desired angle to the grinding wheel. The knife is removed from the carriage at frequent intervals to observe the edge.

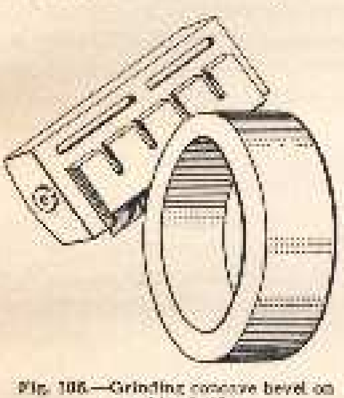


Fig. 106.—Grinding concave bevel on machine knife.

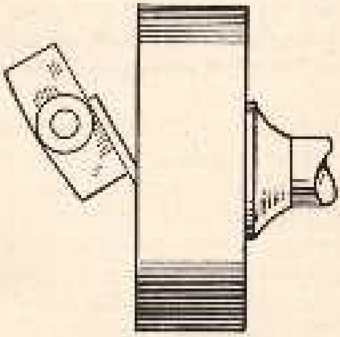


Fig. 107.—Grinding flat bevel on machine knife.

The bevel is sometimes ground concave by the rounded corner of a cup wheel, as shown in Fig. 106, the angle between the knife holder and the spindle of the cup wheel determining the amount of concavity. Usual practice, however, is to grind the bevel flat, using the straight edge of a circular wheel of at least 26-inch diameter, as shown in Fig. 107. Smaller wheels from 14 to 20 inches in diameter are used, but we recommend the larger wheel with a 1½ inch flat face.

The manufacturers of grinding and abrasive wheels recommend certain grades of composition for varying hardness of knives. It is sometimes stated as a general rule for carbon knives, that the harder knives require softer stones. It is necessary to give grinding stones certain care, making sure that their surface is kept free of oil and embedded particles of steel by dressing with a grinding wheel tool.

Grinding Carbon Machine Knives.—All carbon steel knives are ground slowly, with a free play of water on the wheel. Care is required to prevent heating of blade to draw the temper and render the edge soft. This drawing of temper and consequent softness is usually indicated by a blue color showing at the edge on back of the knife. Overheating also tends to set up fine cracks in the steel, beginning at the edge, and extending into the blade ½" to ¼". Both effects result from too rapid grinding.

Grinding High-speed Machine Knives.—As most of the knives now used in school shops are of the high-speed type, it is well to stress the fact that they also require the precaution of slow grinding and care not to heat the edge to show any color during grinding. Dry grinding is generally considered better than wet, as there is less possibility of developing checks or cracks on the edge. If a high-speed knife is ground wet, use plenty of water and never grind so hard that color will show on the edge.

Adjusting Knives in Head.—Due to the high speed of the revolving heads carrying planer, jointer, or shaper knives, care must be exercised in balancing the knives, not only when at rest, but in motion. This balance must cover width, thickness, length, spacing from the bearings, uniformity of bolts, in fact, all adjustable parts, to prevent hammering and strain on the bearing and machine. This perfect balance is secured first by buying knives of uniform quality, carefully made and ground to uniform thickness, and with straight beveled edges. Disston has a well-earned reputation for the quality of the famous Disston Steel used in machine knives, and for care in manufacture, as each knife of a set is weighed on a delicate scale and brought to exact balance.

The second point is to exercise care in adjusting the blade in the groove in the head. When adjusting, the clamp is tightened only enough to prevent the knife from falling out of the head, with the cutting edge extending about ⅛" from the head. A straight edge can be laid on the machine table, at a convenient distance from the circular head, and each knife tapped back by a lead hammer until all knives are equally set to cut the same depth. A knife setting gig is preferred by some operators to do this work. Unless all knives remove the same depth of stock at each revolution, there would be further unevenness in operation and strain on the machine. After the knives are set, the set screws or bolts should be tightened so that the inner face of the knife is flush against the head. If, when using thick composition blades on a square head, shavings work under the face of the knife between it and the head, the blade will be bent back and damage done, for this wedging force will turn back the blade and, if continued, strip the bolts. As a precaution against this Disston makes this blade slightly concave across its face. (See Fig. 102, face 3.)

It merely adds additional strain to a straight knife to set it out further from the head than the amount of cut plus a slight clearance. Seldom need the edge overhang more than 1/8" in small planer or jointer work. Modern developments in clamping the knife in the head have eliminated much of the old trouble of chips packing under the blade. In tightening up bolts, do not exert too much strain and so tear the thread, but be sure they are tight. If the bolt is the old machine type of tapped thread, measure the length of the screw and the depth of the tap to make sure that the bolt does not strike the bottom of the tap before it has locked the blade. A 10" or 12" wrench furnishes sufficient leverage to properly tighten any knife, bolts, or nuts.

Section E

How to Order Machine Knives

Machine knives are designated in the order of (1) length, (2) width, and (3) thickness, some of the large thick planer knives being 30" x 4" x 7/16". Practically all machine knives used in schools are now built for circular heads, and the blade is not slotted as were those for the old square heads. However, in ordering any slotted blade, make a template showing location of slots. We will send you a special paper form which will give you complete directions for laying out this template and which can be used for marking the outline of the knife. In making such an outline, place the flat side of the knife down on the paper, bevel side up, and toward you. Mark on the outline the position of the cutting edge. Return the template with your other specifications on your order.

It will assist us if in addition to (1) length, (2) width, and (3) thickness of each knife, (4) number to a set and (5) number of sets desired, you add the (6) name of the machine, and (7) whether it is a slotted-circular or square head type. This latter information is essential when ordering every machine knife.

Other Types of Knives.—A jointer knife is the same as a planer knife, but generally smaller. Its care, use, and adjustment are identical to that of a planer knife. Shaper knives have a 30 to 42 degree bevel on each side which fits into beveled slots in the faces of the top and bottom collars; these collars are used on vertical spindles. The curve to be reproduced is ground across the face of the knife, with a fairly sharp bevel. The same applies to moulding knives, beading, matcher, and grooving blades. Chipper knives are used to cut up wood for paper, slicing it across the grain. Hog knives are used in mechanical hogs in lumbering to cut up wood scrap for boiler feed. Stave knives cut barrel staves from quartered log lengths, while listing or stave jointing knives shear the edge of the stave to the proper bevel for coopering. Tenoning knives also are used in many woodworking factories and in some vocational school shops.

Advantages of High-speed Steel Knives.—High-speed steel has taken its rightful place of supremacy in the metal industry and it is rapidly coming into universal use in woodworking machinery. In some instances the finest quality of finished lumber has been produced at the rate of 540 lineal feet per minute by the use of high-speed steel and perfectly manufactured knives, in latest types of machines. For this reason it will be well to use this type of knife in your school machines. In high-speed planer, jointer, and shaper knives Disston will bring to your shop the ability to turn out material as well and as rapidly and with as smooth a finish as in industry.

Repair Service.—For the assistance of our friends in the school shops we will regrind your planer or jointer knives. For prices or any other information on machine knives, write our Educational Department. Write also for a re-ordering template.

In our woodworking department, we use large numbers of machine knives and cutters on hardwoods. By reason of this practical experience and continuous test in actual work, together with the fact that we make our own special steel suited to withstand the strains to which machine knives are subjected, we know our knives will give the results you want in your shop.

CHAPTER X

Care and Use of Other Tools

Section A

Try Square

Definition and Description.—The Try Square is a laying-out and testing tool. It consists of two main parts, a steel blade, graduated or ungraduated, and shorter section mounted at right angle to the blade and known as the stock. The stock is usually made of nickel-plated cast iron, as shown in Fig. 145. Another type in which the blade is itself a complete steel square and extends down through a rosewood stock is illustrated in Fig. 146. Try Squares with graduation have inch divisions into eighths, and the inch graduations are most conveniently numbered from the head to the end of the blade. (See Fig. 145.)

Purposes.—1. To serve as a guide for knife, pencil, or scriber, in marking lines at right angles to any straight edge or flat surface.

2. To determine whether surfaces or edges are square with adjoining surfaces or edges.

3. As a straight edge to test surfaces.

Methods of Using.—1. The stock is held by the fingers and thumb of the left hand, as shown in Fig. 108, so that about half the stock lies along the edge from which the material is being squared. For work of accuracy a sharp-pointed sloyd knife is better than a pencil mark. If a pencil is used it should be sharpened to a chisel edge.

2. The piece to be tested should be held in the left hand, if convenient size, and the stock placed against the one surface, as shown in Fig. 109, in order that the line of light between the surface being tested and the blade may show any area which is not square to the other face.

3. To test a surface to determine if it is a true plane the stock is held upright and the back of the blade slid along the surface with the piece held as in Fig. 110.

Fig. 108.—Laying out from face across edge.

Fig. 109.—Truing end from edge.

Fig. 110.—Testing surface.

Cautions in Using.—1. Never use the Try Square as a hammer or mallet.

2. Always keep the stock against true or worked surfaces or edges.

3. Put the Try Square in its slot in the back of the desk after use.

Section B

Sliding T Bevel

Definition and Description.—A Sliding T Bevel consists of a steel blade shaped as shown in Fig. 111, a head known as a stock, and a locking device for holding the blade at angle in the stock. The locking device on bevels is of two kinds—the plain flat head screw adjusted with a screw-driver or with a lever adjustment, as in Fig. 150. These adjustments are the standard where wood stocks are used, and will answer for any purpose except where an adjustment is wanted that will be not only accurate but will also be held rigid for a long period when the same angle is continuously in use. This latter is accomplished by the adjustment in the

Disston No. 3 Bevel, shown in Fig. 149. No. 3 Sliding T Bevel has a quick and positive locking device, a wing nut at the end of the stock where it is easily accessible, but not able to interfere with the use of the bevel on either side. The underside of the locking screw is concave and there is a socket provided for a steel ball. Against this ball the thrust of

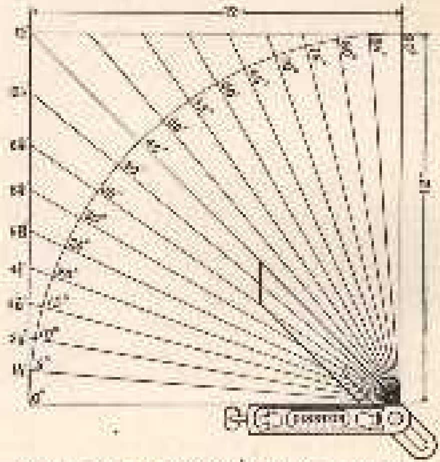


Fig. 111.—Method of setting angles on T bevel.

the rod attached to the wing nut rolls out the inner surface of the locking screw, drawing the two slitted halves of the stock together and clamping the blade at any setting.

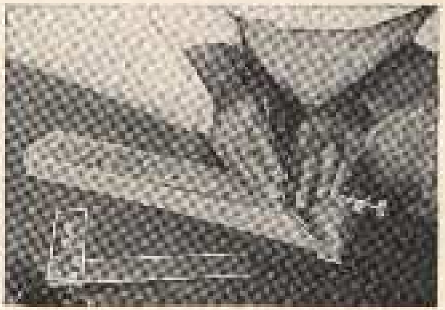


Fig. 112.—Laying out angle from edge across face with T bevel.

Purposes.—1. In laying out to provide a reliable means of duplicating any construction angle.

Method of Use.—1. Figure 111 will show a method of securing approximately any angle in five-degree steps. This may be found of assistance where protractors are not available. With the assistance of a pair of dividers any intermediate angle can be laid out from a point along a straight edge. In cabinet and pattern work, however, protractors are greatly preferred for accuracy to any such method.

2. After the angle is determined, the stock is held against the edge, the blade is adjusted so that its lower edge meets the line, the wing nut is tightened and the bevel is set.

3. Using the stock for a rest, the bevel may be placed along any edge and the angle marked with pencil, scriber, or sharp-pointed knife. (See Fig. 112.)

Section C

Use of Marking Gauges

Definition and Description. The marking gauge usually consists of a bar of wood called a beam, and a movable block of wood known as the head. Near the end of the beam is a marking point called the spur. The head can be set at measured distances from the spur, which is locked to the beam when set. Formerly all beams were graduated to sixteenths of an inch from the spur along the side of the beam. During the life of the gauge these marks become inaccurate. On the Disston Marking Gauge No. 83 (Fig. 151) for schools the graduations have been left off, forcing the pupil to use the ruler in setting.

Purposes.—1. To lay out lines parallel to any straight working surface.

2. They provide a straight line for planing or sawing that will permit of more accurate work.

Method of Using.—1. To set the gauge hold it in the right hand, the thumb pushing the head while the end of the rule held in the left hand presses on the spur side of the head, slide the head until the desired setting is shown on the rule as in Fig. 113; then tighten the screw of the head by the thumb and first finger, check the setting, and the gauge is ready for use.

2. Hold the gauge in the right hand, the thumb pressing against the face of the beam as nearly back of the spur as the setting will permit, with

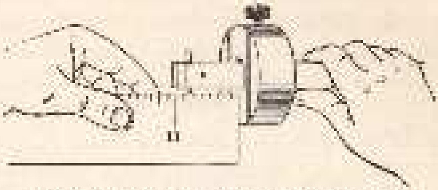


Fig. 113.—Setting marking gauge with rule.

the fingers grasping the bar on either side of the head. This is better understood by observing Fig. 114.

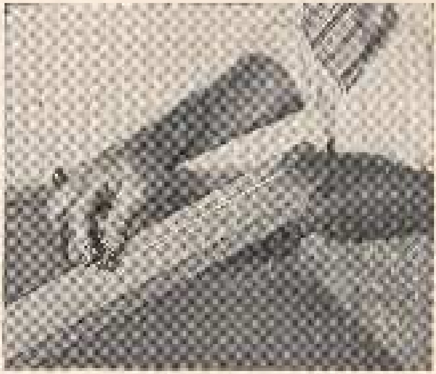


Fig. 114.—Scribing with a marking gauge.

3. With the head of the gauge pressed against the surface being used as a straight surface and with the spur of the gauge tipped back as shown in Fig. 114, push the gauge down the board in such a manner as to cut a clear but not deep line.

Cautions on Use.—1. The spur should not protrude more than an eighth of an inch from the head, one-sixteenth being sufficient.

2. Keep the head tight against the straight edge and do not allow it to chatter as the scribing progresses.

3. Do not tighten the screw in the head more than necessary to clamp it, otherwise this thread will soon be torn out.

Section D

Mortise Gauge

In addition to the regular marking gauge it is necessary to have at least a few mortise gauges in the school shop.

Purpose. To lay out mortises, tenons, or any number of lines from a certain straight edge.

Method of Using.—1. Holding the gauge in the right hand so that the thumb can adjust the slow motion screw, and, with rule in the left hand, spread the two pins the width of the mortise.

2. Set the head the same as directions for the marking gauge.

Section E

Cabinet Scrapers

Scrapers are flat pieces of steel provided with a cutting edge of such a form as to remove stock from wood surfaces when drawn over them. A mistaken idea prevails that scrapers should remove a fine dust. If properly sharpened they will actually plane, removing a fine shaving. In use a scraper blade should be held slightly tilted toward the operator, the thumbs on the lower surface, the fingers pressing down on the upper face. Held at an angle of about 60 degrees the blade is drawn toward the operator with a sweeping stroke.

Sharpening a Scraper for Finishing.—Cabinet Scrapers for finishing need frequent attention to keep them sharp. In renewing the edge or in sharpening a new scraper, the following steps are suggested:

1. File in a vise or grind on a stone all edges of the scraper at right angles to its face.

2. Run a dead smooth file along the edge of the scraper, the file being vertical to its face, the file held across rather than in line with the edge. (See Fig. 115.)

3. Run oil stone along edge to make it smooth.

4. Lay scraper flat on oil stone and rub until there are two sharp edges along all corners.

5. Place scraper in vise and run burnisher along edges in line with the edge, then at an angle of 8 to 10 degrees, and lastly at about 15 degrees.

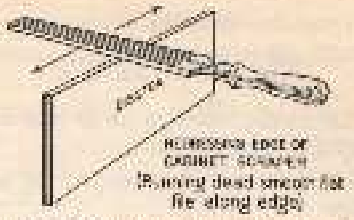


Fig. 115.—Draw filing edge of cabinet scrapers.

In this manner the steel is first pressed out from the edge, then tipped over slightly, and finally bent at about 15 degrees from the edge on both sides. This is shown in Fig. 116.

Fig. 116.—Turning the edge of a cabinet scraper, using [illegible]-inch oval burnisher No. 1.

Some experienced workmen sharpen the scraper by holding it vertical on the bench surface and drawing the burnisher up the edge, toward them, as in Fig. 117.

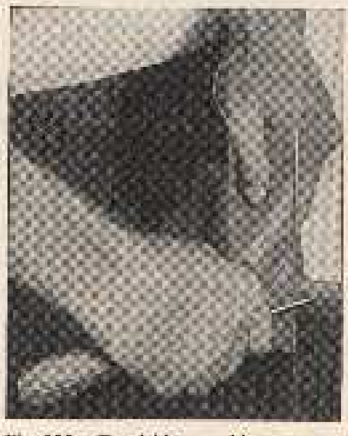


Fig. 117.—Burnishing a cabinet scraper.

Sharpening a Scraper for First Scraping.—The edge of a fast-cutting scraper is usually ground to 30 degree bevel similar to the preparation of any edged tool. The burnisher is then used as in Section E (under Scraper for Finishing) to turn this edge for fast cutting.

Section F

Directions for Honing any Edged Tool

1. Examine the surface of the oil stone to determine that it is flat enough to use and is clear of particles of steel and dirt. Cover the surface, after it has been washed clean with kerosene, with a light oil mixed with kerosene.

2. Grind the blade on a grinding wheel of sufficient fineness. For certain blades, in the absence of a grinding wheel, or in case of other than a straight blade, a suitable smooth single cut file is very effective. In the latter case always file toward the edge.

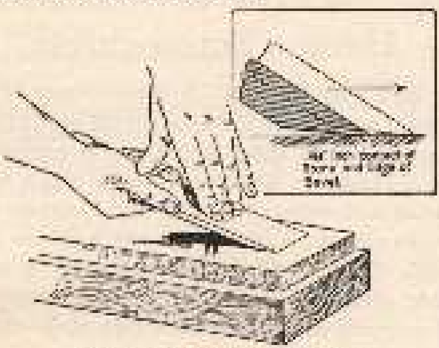


Fig. 118.—Honing a plane blade.

3. Hold the blade in both hands, with its bevel down on the surface of the stone. The right hand supports the under side, the forefingers of the left hand pressing the blade against the stone. Tilt the blade forward until it is in the position on the stone shown in Fig. 118. Press the blade against the stone, pushing it forward over the oiled surface, but do not apply pressure on the return stroke. Keep the angle between the blade and the stone the same throughout the honing. Look

at the blade frequently to be sure that the narrow bright surface is being evenly developed along the edge. It should not be more than the thickness of a dime.

4. During this honing a burr has been set up on the back of the edge. Lay the blade flat on the stone with this edge to the front, and push the blade forward for a few strokes, just enough to remove the burr.

5. Hold the blade with the edge toward the eye in such a manner that any thickness or slight notches in the blade will show as reflected bright lines. If any appear, repeat the third operation until these lines disappear. Inspect frequently. The finer the stone, of course, the finer the final edge. The presence of burrs can best be detected by the light rubbing of the thumb on either side of the edge. The planed surface of a hardwood block is effective in final honing if an exceptionally keen edge is desired. For much work in the school shop such a thin edge is too fine.

Section G

Using a Screw-driver

Definition and Description. A Screw-driver is a handled tool with a wedge-shaped point made to fit the slotted head of ordinary screws. The handle is usually round, and is fluted to give greater gripping qualities when in use. The blade, also known as the shank, is usually round, the end terminating in a wedge of a width and thickness in proportion to its length. The shorter the screw-driver, the narrower and thinner the wedge. The length of a screw-driver is designated by the number of inches of blade extending outside of handle. For cabinet work or where a thin blade and small point are desired there is a type made with these features and designated as cabinet screw-driver.

For electric work there is the Insulate, with a hard rubber handle. In addition to its high dielectric qualities this handle will stand extra hard service without the liability of breaking.

Purposes.—1. Turning wood or machine screws.

Method of Use.—1. In order to guide the point in engaging the slot in the screwhead the driver is held so that the end of the handle rests in the lower center of the palm and pressure is exerted from the shoulder, while all the turning is from the elbow, the wrist being held rigid.

Cautions in Use.—1. Keep the driver in alignment with the axis of the screw and exert sufficient pressure to keep the point in the slot.

2. The screw-driver should not be used as a pinch or pry bar or chisel.

Section H

Comparison of Woodworking Processes

Preparing Flat Work

Hand Tools	Machine
1. Cutting stock to any length, known as "getting out"—Hand Saw (Cross-cut).	Swinging cut-off saw.
2. Preparing Face side, and Face Edge—Jack Plane, Try Square.	Planer, Jointer.
3. Reducing to thickness—Gauge and Jack Plane.	Planer.
4. Reducing to width (rough)—Gauge and Hand Saw (Rip).	Circular Rip Saw.
5. Reducing to width (exact and smooth)—Smooth Plane.	Jointer or Circular Combination Saw.
6. Squaring one end (rough)—Try Square, Hand Saw (Cross-cut).	Circular Cross-cut Saw.
7. Squaring to length (finish)—Rule, Try Square, Back Saw, Plane.	Rule and Circular Combination Saw.

CHAPTER XI

Disston Tools for Schools

IT WOULD be out of character with the purposes of this book to attempt to list in it all the tools that Disston makes.

Nor is it possible to include in the descriptions that follow every tool which the instructor will need.

We have selected the tools for which ordinary school shop practice has created a demand. These are listed and described briefly. Where more than one design of the same tool is available, a comparative description is given, so that the instructor may be able to specify readily.

A reader of this book may have need for a tool not listed here, or for a special tool which he has not previously used.

We are always glad to have inquiries on such questions. Even if it concerns a tool which we do not manufacture, we shall be happy to correspond with any educator on the subject.

We refer the reader to our other publications, which are familiar in many schools. Each of these books fills a definite need, and their data and catalog sections supplement, in many respects, the lists here given.

We are ready at any time to place our manufacturing and market experience at the service of all those who are striving to implant into the minds of the younger generation an appreciation of good tools and the proper use of them.

Every Disston Saw is made to excel in its class. Behind it is the world's greatest and most famous saw works—65 acres, 68 buildings, 3600 Disston-trained workmen.

This plant and its products are great because of two great factors: Disston Steel and Disston Workmanship.

Henry Disston, the founder, with the same steel others used made a better saw. Then, as his saws became better known, he gathered round him other men whom he trained in his own way. He taught them his methods, and, working together with them, he improved these methods until it was impossible to make better saws from the best steel then obtainable from outside sources. His next move was to improve the steel.

So Disston made a study of steel. He mastered steel making, and in 1855 produced Disston Steel. This was the first Crucible Saw Steel made in the United States. And even today Disston is the largest manufacturer of Crucible Saw Steel in America.

There are many kinds of steel. But Disston Saw Steel, after years of successful experimenting, is distinctly different from any other saw steel in the world.

The peculiar special qualities of Disston Steel are best understood through consideration of what is required of the steel in a Disston Saw:

Disston Steel must be stronger than the steel beams which support great buildings;

And tough as the armor-plate that protects a battleship;

It must sharpen to a razor-keen edge;

Be hard, like a bank-vault's door;

Be springy as the main spring of the finest watch;

And polish like a precious metal.

Disston Steel combines all these qualities. It is easy enough to make a steel that possesses any one of them, but it requires perfection in steel making to make a steel that has them all.

Hand Saws

The Hand Saw is the perfection of the saw-maker's art. The success that Henry Disston & Sons, Inc., has had with saws and tools of every kind is based on the hand saw development inaugurated by Henry Disston in 1840.

According to the purpose for which they are used, hand saws are divided into two general classes—Hand Saws for Cross-cutting and Hand Saws for Ripping.

According to their shape, they are divided into two general classes—straight-back and skew-back.

Personal preference is the largest single factor in the choosing of a hand saw. In some parts of the country the demand is for skew-back saws, while in other parts most users want a saw with a straight-back. The skew-back is slightly lighter than the straight-back, while the straight-back is slightly stiffer than the skew-back.

Both straight- and skew-back saws are obtainable in a standard width of blade, also in a width somewhat narrower than the standard. The narrower blade is usually referred to as "ship carpenter's" or "ship pattern" saw. The term had its origin in the demand for a saw which could be used in tight corners and small clearances that are particularly encountered by ship carpenters.

The hand saws listed below, do not represent the entire line of Disston Hand Saws, but cover the patterns in which the school instructor is most likely to be interested.

Since it will probably be easier to consider the various designs shown, if a basis of comparison is offered, the Disston D-8 Saw—"The Saw Most Carpenters Use"—is used as the standard upon which following comparisons are based, and comparative questions are referred to it.

How to Specify a Hand Saw.—There are four points necessary to correctly specify a hand saw:

First: There is the designation, name, or number of the saw. It should be noted here that this designation, name, or number has been arbitrarily assigned by the maker, and in no case does it have any reference to the other specifications by which the saw is described. For instance, the designation "D-8" refers to a type of Disston Hand Saw. This designation has no reference to the number of teeth per inch in the saw, since the D-8 is obtainable in either cross-cut or rip saws in points varying from 4½ to 7 points to the inch for rip and 5 to 11 points for cross-cut. The same remarks apply to "No. 7." Other saws also carry certain standards as to points to inch.

Second: The length of saw desired should be specified. The matter of length refers to the measurement of the cutting edge of the saw and has no reference to the overall length or to any other dimensions. The lengths most generally found in school shops are 22" and 24" for pupils, and 26" for instructors.

Third: Purpose—whether cross-cut or rip. Since, as discussed in the section on hand saws headed "How a Saw Cuts," there is a definite and radical difference in design between the teeth of a cross-cut saw and those of a rip saw, it is necessary to specify the purpose for which the saw will be used.

Fourth: The number of points per inch. The method of determining the number of points per inch is discussed on page 52. It is necessary here only to remark that the number of points will never be the same as the number of teeth per inch. The number of points per inch is invariably one more than the number of teeth per inch, as a moment's inspection of the cut on page 52 will indicate. School shop practice has demonstrated that a certain amount of standardization in points per inch is desirable. For rip saws—saws of 22"—7 points—and 24" length—6 and 7 points to the inch are recommended. In cross-cut saws of corresponding length, 9 points to the inch are recommended.

Following this outline, a specification for a D-8 Rip Saw might read as follows:

Designation:	Disston D-8
Length:	24"
Purpose:	Rip
Points per inch:	7

Every manufacturer uses his own designation for his saws, and it is, of course, always best in specifying a saw to give the name Disston to secure our saws.

D-8 Saw.—This is the most popular Disston Saw for general, all-round work on the job, in the home, or on the school bench. The D-8 is the "original skew back saw" with "let-in" handle, originated and

Fig. 119.—D-8 Hand Saw.

patented by Henry Disston in 1874. The shape of the blade and the position of the handle place the hand closer to the work, and, therefore, give the user better command and guidance of the saw, allow him to make a full stroke, and give more power to his cutting.

When introduced, this saw created a demand which has constantly increased until now there are more Disston D-8 Saws in use than any other one type. It is medium in price. The blade is of the famous Disston-made Steel, taper ground from tooth-edge to back and from butt (or handle-end) to point to give easy clearance in the cut. The tooth edge is of even thickness from end to end. The handle is of apple-wood, polished, and is fitted to the blade with brass screws. The D-8 is regularly made in lengths from 16 inches to 28 inches cross-cut teeth, and 22 inches to 28 inches rip teeth.

No. 7 Saw.—It is upon this saw that Henry Disston built his early reputation as a manufacturer of good saws. The blade of this saw has a straight back. This gives more "body" or stiffness to the blade, and for that reason is preferred by some users who exert a very strong thrust pressure in sawing. The blade is of Disston-made Steel, taper ground from tooth edge to back and from butt (or handle end) to point, and is securely fastened in the well-polished beech handle by brass screws. It is fully warranted, as are all Disston Saws; slightly lower in price than the D-8. It is made in lengths from 16 inches to 28 inches cross-cut teeth, and 22 inches to 28 inches rip teeth.

Fig. 120.—No. 7 Hand Saw.

No. 16 Saw.—The Disston No. 16 Hand Saw is made to suit those who prefer a straight-back saw, with let-in handle. This saw is substantially built and nicely finished.

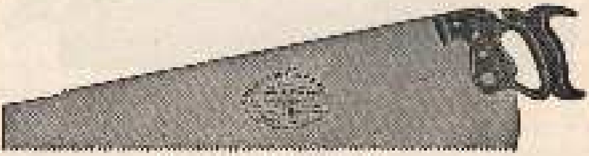


Fig. 121.—No. 16 Hand Saw.

The blade is Disston-made Steel. The handle, of apple wood, is carved and polished and is fastened with brass screws. This saw is equal in quality and workmanship to the D-8 and the cost is the same. It is made in lengths from 20 inches to 26 inches cross-cut teeth, and 26 inches rip teeth.

D-20 Saw.—The D-20 Saw is made particularly for those who prefer a narrow width blade. This blade, skew-back in design, is 1¾ inches

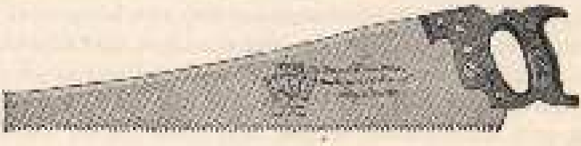


Fig. 122.—D-20 Hand Saw.

wide at the point and 6¼ inches at the butt for 26", instead of 2⅛ inches at the point and 6⅜ inches at the butt, as is the D-8, 26". This makes the D-20 a very light and easy saw to operate. This feature, together with the comfortable grip, makes the D-20 a favorite with some users.

The finish, because it is a grade better than the D-8, makes this saw slightly higher in cost than D-8.

The blade is of Disston-made Steel. The attractively carved and polished handle is of selected applewood and is fastened to the blade by brass screws.

The D-20 is made in lengths from 20 inches to 26 inches cross-cut teeth, and 26 inches rip teeth.

Fig. 123.—D-23 Hand Saw.

D-23.—This is exactly like the D-20, except that the blade is of straight-back design and that the rip saw is made 24 inches and 26 inches.

No. 12 Saw.—Many carpenters and saw users who take pride in having exceptionally well-made and well-finished tools are users of this saw. The No. 12 has a straight-back blade of Disston-made Steel. This blade is extra tempered and will hold its cutting edge longer than the ordinary saw. It is ground thinner than other hand saws, and, as all Disston saws, requires little set. The handle is made of selected applewood and is carved

Fig. 124.—No. 12 Hand Saw.

and polished. This saw is of the best Disston material and workmanship and is very attractively finished. Its cost is slightly higher than any of the saws so far mentioned. It is made in lengths from 18 inches to 28 inches cross-cut teeth, and 24, 26, and 28 inches rip teeth.

No. 112.—The Disston No. 112 Saw is exactly like the No. 12 except that it is made skew back. Sizes: Cross-cut, 20 inches to 26 inches; rip, 26 inches.

D-115 Saw.—This is the finest product of the Disston Saw Works and the best practical hand saw in material, workmanship, and finish that can be found anywhere in the world. Carpenters and others who want a tool of unusual efficiency and beauty are users of this saw. We have made it as good in quality and beautiful in appearance as is possible in a practical tool. The handle is of genuine rosewood, beautifully carved and polished; the screws which fasten the handle to the blade are of brass,

Fig. 125.—D-115 Hand Saw.

nickel plated. Experienced and skilled workmanship has produced a remarkable finish on the blade. The blade, which is of Disston-made steel, has this special workmanship through all processes—hardening, tempering, taper grinding, polishing, setting, filing, etc. Altogether it is a tool worthy of its place as leader of the line of Disston Quality Saws. It is made in lengths from 20 inches to 26 inches cross-cut teeth, and 26 inches rip teeth. The special care and workmanship in this saw naturally make its cost higher than that of an ordinary tool.

The D-15 is exactly like the D-115 except that the blade is straight-back. Made cross-cut teeth, 24 inches and 26 inches; rip, 26 inches.

Back Saws

Three points are necessary to clearly identify a back saw. First: Type. Second: Designation. Third: Length.

A complete specification, therefore, would read as follows:

Type:	Back Saw
Designation:	Disston No. 4
Length:	12 inches

The number of points per inch in back saws has been standardized to insure the best results, and it is not necessary to specify the number of points desired.

No. 4 Back Saw, in either 10" or 12" blade is recommended for school shops. The 10" blade is 2 5/8" under the back, with 15 points to the inch; the 12" blade is 3" under the back, with 14 points to the inch.

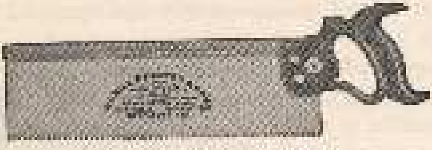


Fig. 126.—No. 4 Back Saw.

It is the tool most frequently used—a necessity on every shop bench. To give service six periods a day, nine months a year, for twelve or more years is the performance of this tool. It is principally used for cutting fine joints on work of small dimensions.

Disston-made Steel is the secret of this performance, and each tooth has more strength to cut and hold its cutting edge. Longer period between resharpening, hence longer life. Steel is uniform total depth of blade, and blade can be used up to the back.

The handle is carefully balanced and securely fastened to blade by two brass screws in 8" and 10", three in 12" to 18". Blade locked in and stiffened by blued steel back. It has carefully filed, sharp teeth which will cut rip, cross grain, or mitre. Set sufficiently to run easily without pressure or binding.

Most instructors have always used this saw and know its performance. For years it has been in universal use in school shops. If you are not familiar with it, we invite you to try this back saw of quality, the most for your saw dollar, because of its accuracy, smoothness of cut, and long wearing keen edge.

No. 14 Back Saw.—This is a special type of back saw for tenoning, dovetailing, shouldering, and dadoing, and special work where a definite depth of cut is desired.

Fig. 127.—No. 14 Back Saw.

This saw is toothed on both edges, being designed for ripping with one edge and cross-cutting with the other. The cross-cut is 13 points to the inch and the rip is 9 points to the inch. It has heavy, slotted steel back, which is quickly adjustable for any depth of cut, by loosening a wing nut and a lever on the handle.

This saw is furnished in convenient school sizes of 8" x 3", 10" x 3", and 12" x 3½".

Cabinet Saw No. 80.—This saw bears some resemblance to the No. 14 Back Saw, except that it is not adjustable to gauge the depth of cut. This makes it possible to cut entirely through a piece of wood, as in the case of the ordinary hand saw. The handle of this saw is adjustable for

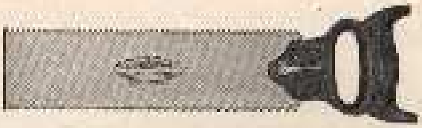


Fig. 124.—No. 80 Cabinet Saw.

position, when either tooth edge is being used. For school use we recommend the 10" or 12" length, both of which are 3½" in width. The rip teeth on this saw are 10 points to the inch. The cross-cut are 15 points to the inch. There is a ⅜" hole at end of the saw, by which it can be hung up.

No. 4 Mitre Box Saw.—Accuracy is the prime essential of the mitre box saw, which is used for sawing mitres for all kinds of work—picture frames, moulding, cabinet work, pattern making, etc. Disston Saws are recognized as the standard mitre saw by prominent makers of mitre boxes. Each saw is given an actual cutting test in a mitre box, to insure accuracy, before it leaves the factory.

Fig. 125.—No. 4 Mitre Box Saw.

Extra care is exercised in making these saws so they will run true and cut a smooth accurate joint.

To prevent the "butt" or "heel" from catching in the work when the saw is used in a mitre box, this type of saw is made so that the cutting edge is two inches shorter than the entire blade. Because of the nature of the work to be done, the blade is made thin, but is reinforced for stiffness by having the upper edge inserted in a steel back. It is a fine tooth saw. The standard for all lengths is 11 points to the inch.

The blade is of Disston-made Steel, the handle of applewood, fastened with brass screws. The back is of blued steel. The saw is made in 20 to 32 inch lengths. Each length is made in three widths—4, 5, and 6 inches wide under the back.

Fig. 130.—No. 8 Half Back Bench Saw.

Half Back Bench Saw No. 8. Combining the action of both the hand saw and the back saw, there is the so-called half back bench saw, available in 14- to 20-inch lengths. It gives both the advantage of a stiffened cutting edge and the ability to cut entirely through the work.

Dovetail Saws

For fine and accurate work both the cabinet and pattern maker have long appreciated the advantages of an exceptionally thin blade held in a rigid, steel back.

All these saws are of 26 gauge Disston-made Steel, 1½" wide under the back and 17 points to the inch.

Fig. 131.—No. 68 Dovetail Saw.

No. 68.—Provided with a straight, hardwood handle rigidly attached to an extension of the back; made in 6" to 12" lengths. This saw permits very close and accurate cutting along a straight line, the use of a plane in general not being necessary before glueing. Either the 6- or 8-inch length is recommended for school use.

No. 70.—The diminutive saw handle on this type dovetail saw is sp-

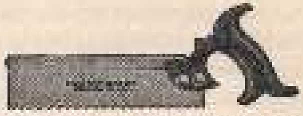


Fig. 132.—No. 70 Dovetail Saw.

proved by certain workmen and convenient for grip of small pupils. It is well adapted to use in the school shop. Either the 6- or 8-inch length is well suited for school use.

Fig. 133.—No. 71 Dovetail Saw with offset handle.

No. 71.—The handle on this saw is exactly the same as on the No. 66 excepting that handle and back are offset sufficiently to permit work on flat surface. With this saw the user may cut with the blade flush to the board in a floor or wall. The 8" length is recommended for school use.

Keyhole and Compass Saws

This type of special purpose saws is excellent for hand cutting of all curves. It requires an exceptionally high-grade steel to stand the strain of narrow blades being thrust through the work. This requirement is fully met by Disston-made Steel.

No. 95 Keyhole Saw.—This is a very convenient, effective type of saw, answering both the requirements of a keyhole and compass saw. It has a Disston Steel blade, with a thin back that permits cutting small curves of short radii, as well as any type of cut where it is impossible to insert the point of other saws. The blade is 10" long, 10 points to an inch,

Fig. 134.—No. 95 Keyhole Saw and Pad.

and by adjusting a clamping screw, which operates a steel grip inside the handle, all or part of the blade may be used as desired. This adjustment prevents the buckling of blades when starting the cut. Handle is hardwood, ferrule is nickel plated. Extra blades for No. 95 can be ordered as needed.

Fig. 155.—No. 5 Keyhole Saw and Pad.

No. 5 Keyhole Saw.—For those who require an inexpensive small saw for irregular curves. Blade is adjustable to any length by action of hexagonal-headed locking screw. Blade is 7 inches long, 10 points to inch, of steel specially tempered for the peculiar nature of the cutting. Extra blades for No. 5 can be ordered as needed.

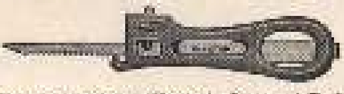


Fig. 156.—No. 10 Keyhole Saw and Pad.

No. 10 Keyhole Saw.—The positive locking device assures that the blade remains in place irrespective of the thrust on the blade. The blades are 7 inches long, 10 points to the inch, of special steel adapted to the duties of this saw. Extra blades for No. 10 can be ordered as needed.

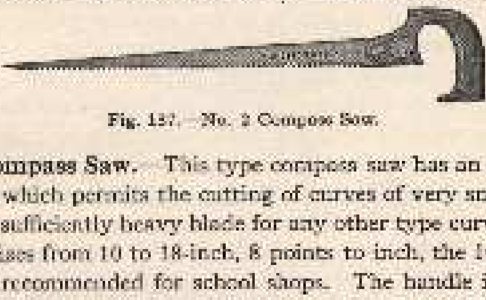
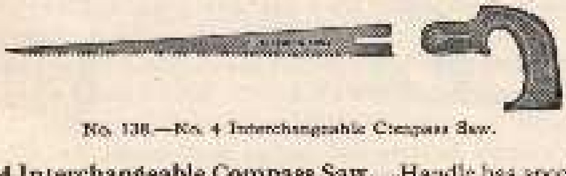


Fig. 157.—No. 2 Compass Saw.

No. 2 Compass Saw.—This type compass saw has an exceptionally narrow point which permits the cutting of curves of very small radii, and also provides sufficiently heavy blade for any other type curve. Although available in sizes from 10 to 18-inch, 8 points to inch, the 10, 12, and 14-inch sizes are recommended for school shops. The handle is so designed that the center of thrust is directly in line with the blade, thus giving very accurate control. Work is usually begun in this type of operation by drilling a hole with a brace and bit.



No. 158.—No. 4 Interchangeable Compass Saw.

No. 4 Interchangeable Compass Saw.—Handle has special adjusting lever, so as to allow final locked position of the lever to lie alongside of handle. The pin in the head of the lever bolt is moved to adapt to various thicknesses of saw blades. Will take 10, 12, 14, 16, 18 inch blades. With this saw it is possible to use blades of different sizes for different kinds of work in the same handle. Blades are quickly removed and replaced.

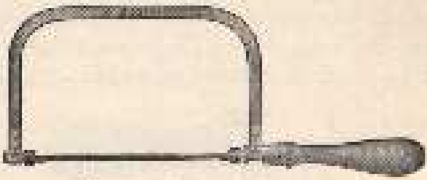


Fig. 139.—No. 10 Coping Saw.

No. 10 Coping Saw.—The rigid, steel frame of this saw permits adjustment of the blade tension through turning of the handle. Proper tensioning reduces the breakage of blades, and is thus a feature in saving the instructor's time. Lock-nut adjusts the position of the handle at any setting. The blade can be swung at any angle to permit extra depth of cut. This saw when used with the No. 10 Coping Blade easily follows the line, cuts fast and smooth through any thickness of stock. The frame is 4 ½" deep from blade to back. The No. 10 Coping Saw Blades are cut to give clearance required in curved work. Due to their composition, they will stand considerable bending and misuse without breakage. The end pins are pressed in place and the blades are 6 ½" from pin to pin.

All instructors are familiar with the old fashioned wire frame coping saw, provided with a wire blade notched to form teeth, and cutting on the "pull" stroke. This is probably the least efficient and most unsatisfactory tool used for school work. The number of blades broken, the lack of confidence of the pupil in his own work, are reasons enough for searching for a better tool and sturdier blade.

Our No. 10 Coping Saw has a rigid steel frame and is provided with stretchers which permit the blade being put under the proper tension. This is the first secret of better performance, a blade held so that it can do its work irrespective of its small size. The second basis for better coping and fret work is a good blade, with correctly cut teeth. This blade will stand unusual twisting and sawing at all angles, for it is made of good steel and provided with enough set to clear the blade in curved work.

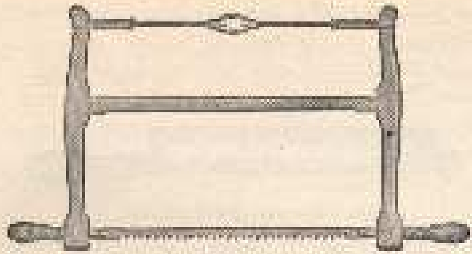


Fig. 140.—Web Saw complete.

Web or Turning Saw Frame.—Although one of the oldest types of saw, the web pattern permits doing by hand work that would otherwise require a band or jig saw. The frame consists of two uprights and cross-piece with mortise and tenon joints to permit easy assembling or dismounting the saws. The frames are available in 12, 14, 16, 18, and 20" sizes. For the school shop we recommend either 14" or 18" size. Handles with a tang slitted and drilled to receive and lock blade are furnished as part of the frame. Blades used are usually ½" wide, 10 points to inch, and are punched on both ends for fastening in handles.

Hack Saws

Fig. 141.—No. 100 Hack Saw.

No. 100 Hack Saw.—Steel frame with riveted sockets, stretcher permitting turning blade to right angles with frame on deep cuts. Sturdy frame built for service. Takes 8" blades. Limit from cutting edge to inside of frame is 3⅞". Handle is hardwood, firmly fastened to stretcher.

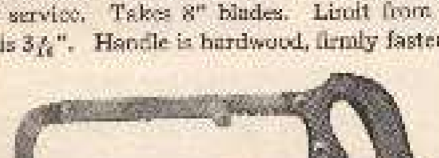


Fig. 142.—No. 36½ Adjustable Hack Saw.

No. 36½ Adjustable Hack Saw.—Sturdy steel frame, adjustable by half inches from 8" to 12". The back of this saw will not wobble and when blade is properly stretched the tool is strong and rigid. Stretchers cannot fall out when changing blades. Special handle is of hardwood stained black, places cutting thrust at right place for best work.

Fig. 143. No. 200 Hack Saw.

No. 200 Hack Saw.—For close quarters. Particularly designed for narrow work, inconvenient to reach with other type saws. Also low back assures steadying the saw at the front, preventing side twist, a cause of breaking many saw blades. Takes 8" blade. A handy hack saw for boys.

Hack Saw Blades

The foundation of Disston Hack Saws is a special alloy steel developed in our own steel works for this particular use. This steel is unusual for the fineness of its grain and its extreme toughness.

Added to this is special and uniform heat treatment based on more than 85 years' experience.

The teeth in Disston blades are milled and, therefore, are uniform and not distorted—there is no slipping or pinching in the work because of irregularities in the blade.

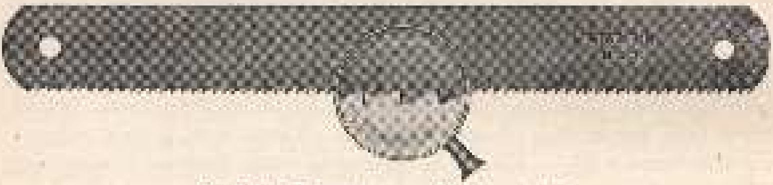


Fig. 144. Enlarged view of hack saw teeth.

The teeth are milled at a special angle which experiments have shown gives maximum speed and durability. In addition, every third tooth is left with no set and is called a "cleaner" tooth. This "cleaner" tooth plows straight through the cut and carries out the chips which, with ordinary blades, slow up cutting speed and dull the teeth.

Disston "Duraflex" or Flexible Blades. Hardened on the tooth-edge only and tempered in the body of the blade so that they may be bent or twisted without breaking easily. For schools, where hack saws are used by beginners, we can recommend no better blade than this. Lengths range from 8 to 12 inches, 14 to 32 teeth per inch.

Disston "Improved Chromol" or All-hard Blades.—This blade is of uniform hardness throughout. It offers maximum cutting speed and efficiency. Lengths from 8 to 14 inches; 14 to 32 teeth per inch.

Disston "Improved Chromol" Machine Hack Saw Blades.—These blades offer the same advantages over ordinary blades for machine use as are enumerated before. Made in 10, 12, and 14-inch lengths; 5/8" wide: 14, 18, or 24 teeth per inch for light gravity feed machines. For heavy machines, available in 10, 12, 14, 16, 17, 18, 20, and 24-inch lengths; 3/4" and 1" widths: 8, 10, 14, or 18 teeth per inch.

Other Bench Tools

Try Square No. 5½.—Knowing the severe use, even mistreatment, which a try square receives in the school shop, we have built our No. 5½ not only accurately, but with an abundance of strength to stand "the bumps."

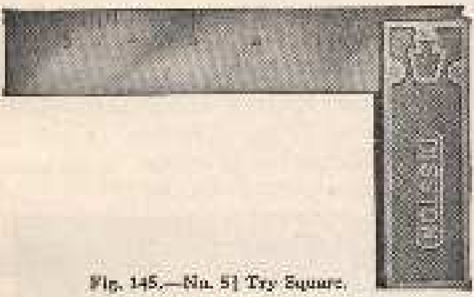


Fig. 145.—No. 5½ Try Square.

Blade is heavy gauge, toughened steel, graduated eighths of an inch. Your special attention is called to the fact that the blade is correctly numbered from stock to end of blade.

The blade is fitted tightly in a nickel-plated stock and, after being accurately set, is permanently locked square by three heavy rivets.

Stock is made with profiled face to reduce weight and secure proper balance when stock projects over edge of work. This tool is square both inside and out.

Sizes range from 4 to 12 inches, either 6 or 8 inch being popular sizes for the school shop.

Try Square No. 15.—For the instructor who prefers the wooden handled try square, but who has experienced difficulty in getting a type which will remain accurate under the strenuous use of the school shop, we recommend the No. 15. As shown by the cut, the steel blade is L-shaped, so that its squareness cannot be destroyed by the beam working loose. The stock is rosewood, slitted to receive the blade and held to it by four

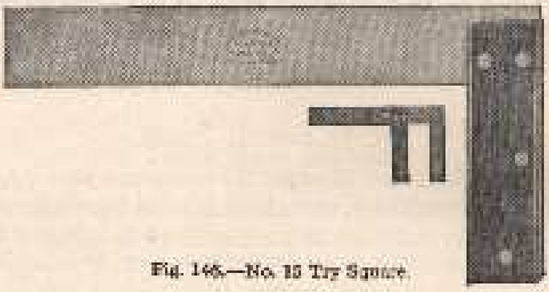


Fig. 146.—No. 15 Try Square.

large rivets. The bearing face of the beam is further reinforced by a heavy brass plate, fastened to the beam by countersunk screws, the heads of which have been ground off flush with the plate. Unless otherwise specified the blade of this try square is without graduations. If preferred it can be ordered graduated eighths of an inch. A well-balanced, easily handled tool, which cannot get out of square. School sizes 6, 8, and 10 inches.

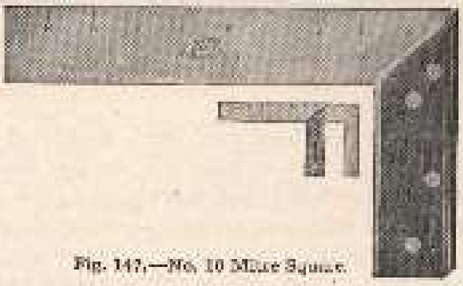


Fig. 147.—No. 10 Mitre Square.

Mitre Square No. 10.—For a mitre square combining ease of handling and accuracy our No. 10 will give best service under strenuous school use.

As shown in the cut, the complete L-shaped blade is accurately squared and fitted with a genuine rosewood stock. While the back of the stock is flush with the steel blade, the face is reinforced along its straight and mitre edge by a strip of heavy brass plate, fastened to the beam with countersunk screws ground flush. Blade is toughened steel, graduated to eighths of an inch and numbered from stock to end. The mitre square combines two tools in one, and is gaining wider popularity in school work. Usual sizes are 6, 7½, 9, and 12 inches, the 6, 9, and 12 being popular in school shops.

Mitre Square No. 11.—For those who appreciate the effectiveness of the mitre square over the try square and also want a metal stock, we recommend our No. 11. As in all our other squares the blade is special toughened steel, graduated in eighths of an inch. The stock is nickel

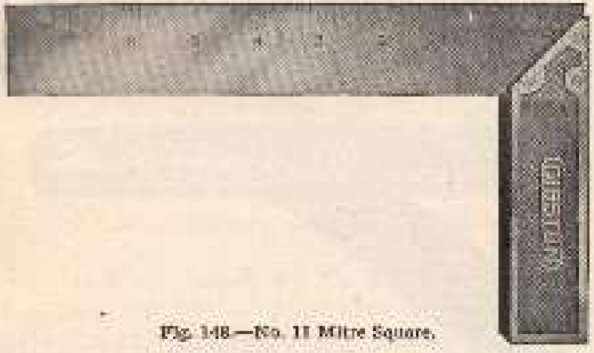


Fig. 148—No. 11 Mitre Square.

plated profiled to give balance to the tool when the stock projects over the edge of the work, and securely locked square by three strong rivets. For a metal tool this mitre square is comparatively light in weight. This tool is square both inside and out. Although available in sizes from 2 to 12 inches, usual school sizes are 6, 8, and 12 inches.

T Bevel No. 3.—This metal T Bevel is superior for school shops, as its locking nut is at the end of the stock, out of the way, and this device is so positive that the setting is not lost, even if the tool is accidentally dropped after adjustment. A turn of the wing nut is all that is necessary to clamp the toughened steel blade at any angle, and this locking is possible throughout life of tool. The blade is nearer one face of the stock to give greater purchase against the laying out edge. School sizes are 6, 8, and 10 inches, which is the overall length of blade.

Fig. 149.—No. 3 T Bevel.

T Bevel No. 2.—For those who prefer a wooden beamed T Bevel we call your attention to our No. 2, the construction of the stock providing an offset which keeps the lever nut out of the way. Blued steel blade, rosewood stock. Sizes 6 to 12 inches, 6, 8, and 12 being recommended for school shop.

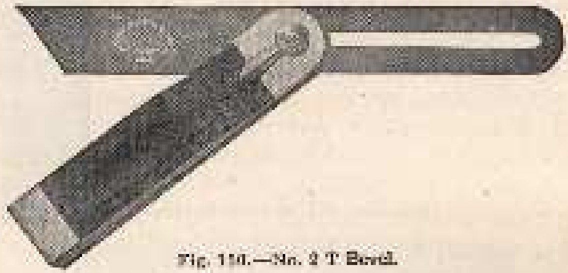


Fig. 150.—No. 2 T Bevel.

Marking Gauge No. 83.—Designed by instructors of woodworking for use in their own shops. A tool for a purpose. Heavy spur of highly tempered steel. Spur sharpened to a knife edge and will not follow the grain of wood. Smooth scribing cut. Spur stays sharp without frequent filing. Spur flat on inner face, giving accuracy of cut. The oval head is best shape for getting into corners and rocking the head to any depth of cut you desire to make.

The thread holding the head is given longer life by the knurled screw which allows the fingers to slip after the head is locked. The thread is not easily damaged or the head split; neither is there any way of twisting the screw in a vise. The graduations have been left off the stock. No chance of inaccuracy from that source: the pupil must use his rule. Screw in end of shaft prevents removal of head and usual loss of gib. Gauge is made of cherry, a wood little affected by moisture. No immovable heads after vacation if you use this gauge. All metal parts brass, including rein-

Fig. 151.—No. 83 Gauge.

forcing strips across the face of the head. A light weight, yet effective gauge, built by a fellow instructor to solve your gauge problem. This gauge is made in one size, with 9-inch bar, and $\frac{7}{8}$ by $2\frac{1}{8}$ inch oval head, spur $1\frac{1}{8}$ inches long. Its proportions make it fit the hand and do effective scribing.

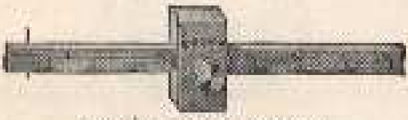


Fig. 152.—No. 84½ Gauge.

No. 84½ Marking Gauge.—For the instructor who prefers a small steel scribing point and a boxwood gauge we recommend our No. 84½. It is equipped with a brass knurled screw to prevent overtightening of the locking device and splitting of the head. Head has two parallel inlaid brass plates to take up wear of head, graduated sixteenths of an inch, and numbered to 8 inches. Of its type the best built gauge and one that will give full service in the school shop.

Fig. 153. No. 96 Mortise Gauge.

Mortise Gauges.—The head and stock of No. 96 mortise gauge are made of boxwood. The mortise setting is adjusted by means of a slow motion slide moved by knurled brass screw. Head is heavily brass plated and securely set by knurled screw. Stock is graduated. A superior tool.

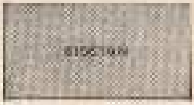


Fig. 154.—Cabinet Scraper.

Cabinet Scrapers.—The necessity for high-grade tool steel of uniform hardness is appreciated by anyone who has ever had to burnish and use a cabinet scraper. Disston blades are pliable and will hold their edge longer. They are furnished with either straight cut edges, or with edges dressed and ground, the latter type being ready to burnish without further dressing on the oil stone, and is proportionally more expensive. Although sizes range from 2 by 4 inches to 4 by 6 inches, the sizes most frequently used in the school shop are the 2½ by 5" and the 3 by 6".

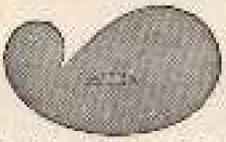


Fig. 155.—Swan Neck Scraper.

Swan Neck Scrapers.—This style scraper blade is well adapted to finishing those concave curves frequently met in pattern work and interior curves of cabinet making. The blades are of uniform hardness, high-grade tool steel, and when properly burnished will cut smoothly and hold their cutting edge longer without resharpening.

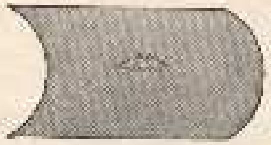


Fig. 156.—French Scraper.

French Cabinet Scrapers.—This style cabinet scraper has two straight edges in addition to concave and convex curves, frequently needed in joinery, cabinet making, and pattern work. They are made of high-grade tool steel, uniformly hardened, and capable of taking a smooth cutting edge by use of the burnisher. Will hold edge longer without redressing.

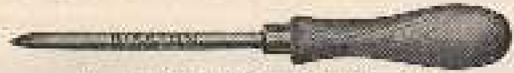


Fig. 157.—No. 1. Oval Cabinet Burnisher.

Cabinet Burnisher.—Made of steel of sufficient hardness to turn the edge of scrapers without grooving the burnisher. The oval shape is easy to hold and gives sufficient leverage to facilitate upsetting the edge. Blade is fastened in hardwood handle, strengthened by nickel-plated ferrule. The 4½-inch length is most popular in the school shop, although we also make the 6-inch size for those who prefer a longer and heavier burnisher.

Screw-drivers

Number 9.—This screw-driver has Disston steel blade extending through handle to capped end pinned end, as shown on cross-sectioned cut. Blade tested both for prying and turning of 100 pounds per inch before handling. Through pin, ending in heavy ferrule, locks together blade and maple wood handle, preventing any loosening or turning

Fig. 158.—No. 9. Through tang, capped end Screw-driver.

of handle. Cap carries end hammer blow to blade, so that this screw-driver will withstand the hard use of school shops without the annoyance of split or broken handles. Blade lengths (not including handle) are 3 inches to 12 inches, of which we recommend an assortment for your shop.

Fig. 159.—No. 31. Cabinet-makers' Screw-driver.

Number 31.—A convenient screw-driver of cabinet-makers' type, with small diameter blade and reinforced pin through ferrule and handle. Blade of Disston steel. An excellent screw-driver for small screws, under shelves, back of panels, in bottom of recesses, inside radio sets, etc. Blade lengths (not including handle) are from 2 inches to 12 inches.

Number 50, known as the "Insulate," is a safe screw-driver for use in fuse and starting boxes, electric light and power sockets. Every shop needs a few of these insulated screw-drivers, which can be used around any circuit without gloves even if the operator is standing on cement

Fig. 160.—Insulate No. 50 Screw-driver. Particularly adapted for electricians' use.

or in water. Only made in 6-inch length, overall. Disston steel blade heavily embedded in hard rubber. Blade has fins or rings along its length which grip the handle and permanently lock it in place. Handle can be dropped on cement without danger of cracking.

Plumbs and Levels

Plumbs and Levels. What is the basis of a satisfactory plumb and level? In the first place, straight grained hardwood, carefully selected, air and kiln dried. Second, the best leveling bubble. And third, and most important, is the painstaking craftsmanship which assures that each operation is carefully performed and the rigid inspection which checks the accuracy of the finished work. A tool of accuracy such as a plumb and level cannot be "nearly right." To be sure of the result you need a dependable tool.

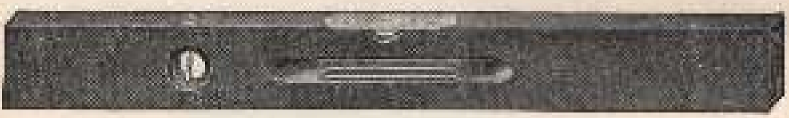


Fig. 161.—No. 9 Plumb and Level.

Our No. 9 Plumb and Level is made from well seasoned, carefully selected hardwood polished with arch top plate, as shown in Fig. 161, 24" to 30" in length, and the 24 inch length is suitable for the school shop. Level and Plumb glasses are set solid.

Besides the fixed or locked type of bubble, Disston makes an Adjustable type which may be adjusted at any time that rough usage or climatic conditions have altered its accuracy.

Figure 163 explains this feature. To adjust the level, loosen flathead

Fig. 162.—No. 16 Adjustable Plumb and Level.

screw, raise or lower round head screw until bubble is true; then tighten flathead screw. To adjust the plumb, remove the protecting shield, loosen one screw, and tighten the other until the bubble is true. Our No. 16, shown in Fig. 162, is an Adjustable Plumb and Level, arch top

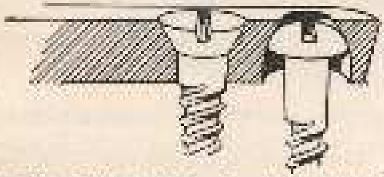


Fig. 163.—Adjusting device for plumb and level.

plate, two side views, solid brass ends, polished hardwood, 24" to 30" in length. The 26-inch length is suitable and dependable for school shops.

For school use with advanced pupils it is better practice to order an Adjustable Plumb and Level.

Brick Trowels

The present trend is toward a simplification and standardization of the types of brick trowels used. The important features in the construction of trowels are the same in most patterns, the difference in many cases being a slight change in the shape of the blade.

We show two popular patterns. The features found in them will be found in other Disston brick trowels.

Our brick trowels are made of Disston Steel, hardened and tempered the Disston way, and taper ground from heel to point. The blade and tang are one solid piece of Disston Steel. The trowel posts are at a true right angle to the blade to give proper lift and balance.

In all Disston brick trowels is found the new Disston invention—especially important to schools—the spiral tang: a method of locking the handle to the blade so that it will not come off. The steel tang is spiral shaped. The handle is forced on to this tang with a revolving motion

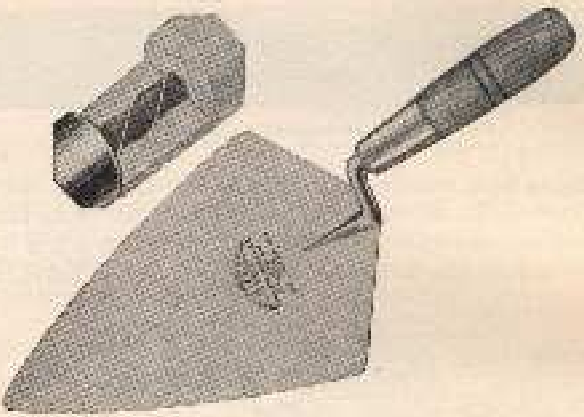


Fig. 164. No. 36 Brick Trowel showing method of locking handle to blade.

at great pressure. The spiral tang locks tightly to the wood all the way in. (See exposed section above.) This means a real saving and better work in school shops.

The No. 36 brick trowel is light weight, flexible, wide-heel pattern, made in the approved shape. It is the popular pattern where wide-heel, flexible blades are used.

The No. 136 is like the No. 36 excepting it has a leather grip.

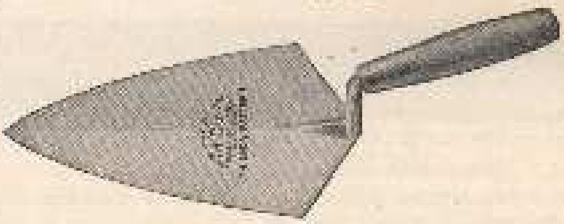


Fig. 165.—No. 12 Brick Trowel.

The No. 12 is made in the same way as the No. 36 excepting that this is a longer blade with a narrower heel and is slightly heavier in gauge than the No. 36.

These trowels, and the other patterns in the Disston complete line, can be had in all standard sizes. The ones most commonly used in school shops are 10," 10½", 11", and 12".

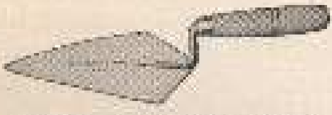


Fig. 166.—No. 15 Pointing Trowel.

Pointing Trowels.—Our regular Pointing Trowel No. 15 is well adapted for vocational work. Best size 5 or 5½ inches.

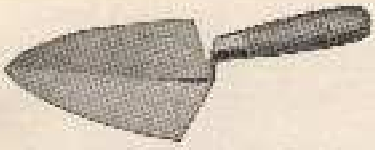


Fig. 167.—No. 35 Tile Setting Trowel.

Tile Setters.—Where this work is given as a part of the vocational course we refer you to our No. 35 Tile Setter's Trowel shown in Fig. 167, size 6½ by 3½ inches.

Plastering Trowels

Not so very many years ago when plaster was prepared from lime and hair, the workmen needed a trowel to apply the browning coat and a finishing trowel. This plaster was worked slowly and the blade of the trowel was comparatively heavy gauge. Today, with the quick-setting

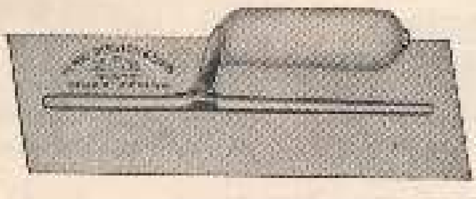


Fig. 168.—No. 28 Plastering Trowel.

cellulose plasters, there is a growing insistence on thin gauge tools. To fasten these thinner blades to the mountings we make a special countersink so that the ground face of the rivet will contine to hold the blade as long as it is in use. Another feature is the fitting of the handle to the upright post so as to give an easy thumb grip on the post. Both these features are shown in Trowel No. 28 (Fig. 168). The 11 by 4½ inch blade is recommended for vocational school work, although sizes range from 10½ to 12 inches.

In cornice work, in arches, or overhead it is necessary for the plasterer to swing the trowel and allow it to rotate in his hand as it is raised above his head. The ordinary straight handle may not clear the operator's

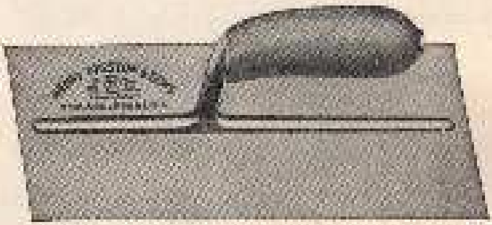


Fig. 168.—No. 28 Plastering Trowel.

knuckles. An examination of Fig. 169 shows the No. 38 finishing trowel with a type of handle which allows plenty of knuckle room. This trowel is also flexible. It is No. 24 gauge, or .022 inch thick. Ten countersunk rivets with flush ground heads hold it to its mounting. For school use we recommend the 11 by 4½ inch size.

Circle Trowel.—No. 24 inside circle trowel is shown in Fig. 170.

Corner Trowel.—The 6-inch size, shown in Fig. 171, is made in both inside and outside patterns.

Fig. 170.—No. 24 Circle Trowel.

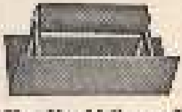


Fig. 171.—No. 26 Corner Trowel.

Cementer's Trowel.—Without question our No. 48 in 11 by 4 inch blade, also made 12 by 4 inch and 14 by 4 inch, with the same handle as the No. 38 finishing trowel, of 22 gauge, to stand the greater strain of cement work, is the best tool of its kind. This handle permits of long operation with minimum fatigue. The mounting is fastened to the Disston Steel blade by ten countersunk, flush ground rivets.

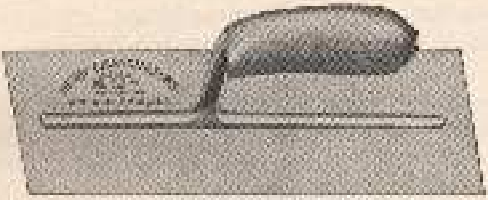


Fig. 172.—No. 48 Cementing Trowel.

Cementer's Edging Trowel.—For edging pavements, flooring, curbing, driveways, the No. 50 trowel in 11-inch size will be found satisfactory for training and trade use. It is shown in Fig. 173.

Fig. 173.—No. 50 Cementer's Edging Trowel.

Fig. 174.—No. 105 Masons' Plumb and Level.

Masons' Plumb and Level.—Figure 174 shows the No. 105, 42-inch adjustable plumb and level with level and plumb glass. It is made of polished straight grained stock and has an arch top plate. Suitable for vocational school and trade work.

Power Saws

Following are listed the Band Saws, Circular Saws, Dados, Machine Knives, etc., used on school shop machines.

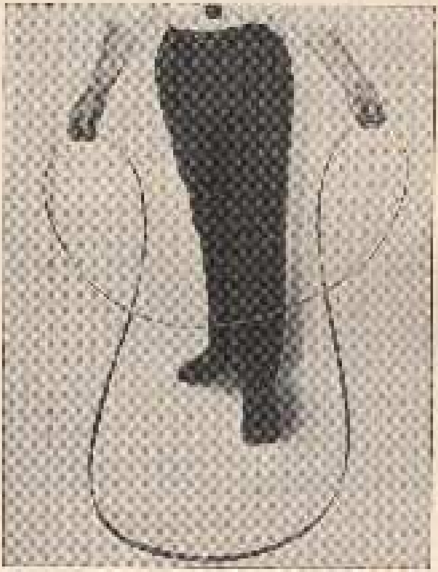


Fig. 175.—Method of folding a narrow band saw.

Narrow Band Saws.—Before ordering band saws it is well to consider the information on pages 60 to 63. Unless specified, saws are not furnished brazed, although we are able to prepare band saws to any specification, brazed.

Width, Inches...	1/8	3/16	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2
Points per inch..	8	7	6	5 1/2	5	4 1/2	4	4	3 1/2	3 1/2	3 1/2	3
Gauge..........	23	22	22	22	21	21	21	20	20	20	20	19

In ordering Band Saw specify:

1. Width.
2. Length.
3. Brazed or not brazed.

Note: Unless otherwise specified, standard gauge and teeth as shown on page 178 will be furnished.

If you are in doubt as to the exact length of band saw for your machine, give the type of machine, size of wheel, and distance between centers of wheels, with wheel extended to total reach. This will be sufficient data for our furnishing you a brazed saw of proper length to suit your machine. As different manufactures of band saw machines have wheels different distances between centers, do not just ask for saw to fit 30-inch wheels. Always give center to center distance as well.

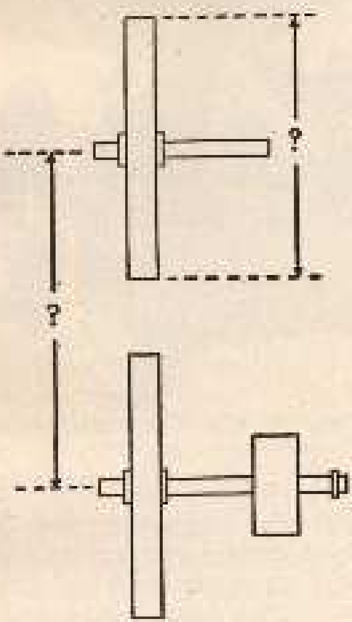


Fig. 176.—Necessary measurements for figuring length of band saw.

Special Gauge for Small Diameter Wheels.—Band saw machines having wheels less than 20 inches in diameter require our "Special Gauge" band saw, two to three gauges thinner than standard, to hold up without breakage under the strain of bending on the smaller wheels. To get the type desired for small machines be sure to state that you want "Special Gauge" for ____ diameter wheels.

Tools for Fitting Narrow Band Saws

It is no longer practiced to file or set band saws by hand. Machines have been perfected which not only do this work quicker, but, what is even more important, more effectively, teeth will be evenly set and filed regularly, resulting in better band saw work.

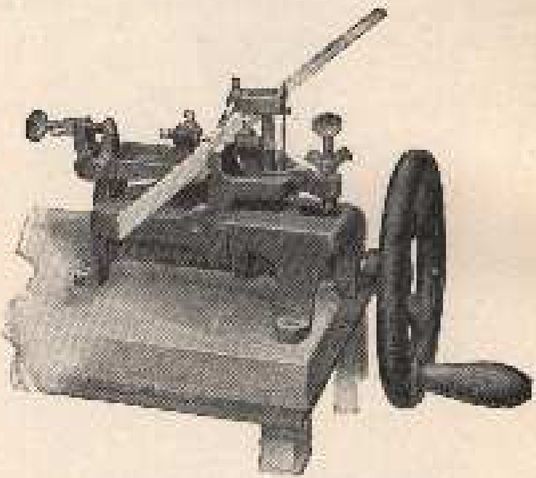


Fig. 177. Band Saw Setting Machine.

Setting Machine.—Will set saws 1/8" to 1 1/2" wide, with teeth spaced 1/8" to 1/4". The vise automatically locks blade before plunger presses on teeth. Pawl advances blade and saw teeth are set right and left. Exact amount of set can be regulated. Operated at about 100 revolutions per minute, setting an entire band saw in from four to five minutes, evenly and accurately.

Filing Machine for Power.—Will file saws 1/8" to 1 1/2" wide, with teeth spaced 1/8" to 5/8". Pawl automatically advances teeth so that file operating on their cutting and back surface, can be used on saws that have uneven teeth due to previous hand filing, and will correct this irregularity, making each tooth do its part of the sawing. Saw will run true in the cut if filed by machine.

Operates at 50 to 60 revolutions per minute. Uses 6-inch regular

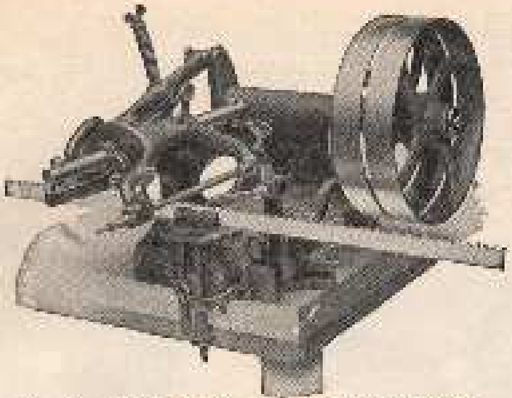


Fig. 175. Band Saw Filing Machine (power driven).

taper file. Machine completely equipped. A half horse-power motor will run this machine, or it can be belted to pulley on shop line shafting.

Circular Saws

Consideration of the speed that circular saws attain in normal operation is sufficient basis for realizing that best material and workmanship are required to manufacture saws that will run true in the cut without binding, hold their edge, and cut smoothly. Disston Steel and the experience of eighty-five years are the foundations for our guarantee that all our saws will give a full measure of satisfactory service. There is much workmanship on every circular saw which can be determined not by surface examination, but by actual running test. Such qualities as tension and the real edge-holding steel are some of the things built into our saws for smooth ripping and cross-cutting.

In ordering a circular saw specify:

1. Type of saw wanted, Rip, Cross-cut, or Combination.
2. Diameter in inches.
3. Size of mandrel hole.
4. Style of teeth wanted in saw. (See Fig. 73.)
5. How many teeth wanted in saw.
6. Thickness or gauge of saw at rim.
7. Speed at which saw will be run (R.P.M.).
8. Kind of wood to be cut.

Rip Saws.—Saws range from 3 to 14 inches in diameter, and mandrel hole diameter should also be given on specifications. Saws are spring set up to 10 inch, and either spring or swage set over that. Usual school sizes are 10, 12, and 14 inches. Give number of teeth from standard tables on page 72. We recommend the No. 11 or No. 14 tooth for use in school work.

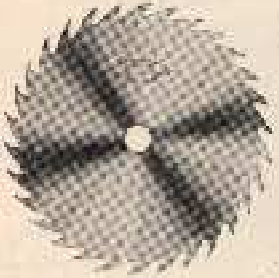


Fig. 179.—Rip Circular Saw.

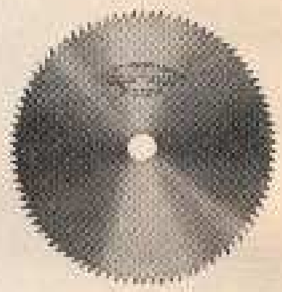


Fig. 180.—Cross-cut Circular Saw.

Cross-cut Saws.—For cross-cutting finer teeth are necessary than for ripping. Standard table, page 72, shows the number of teeth usually specified. More teeth per saw can be ordered if desired, but be sure to give the type of tooth, the best types of which are our Nos. 2 and 4.

Novelty or Combination Saws.—In the school shop speed in ripping or cross-cutting by a circular saw is not as essential as smoothness

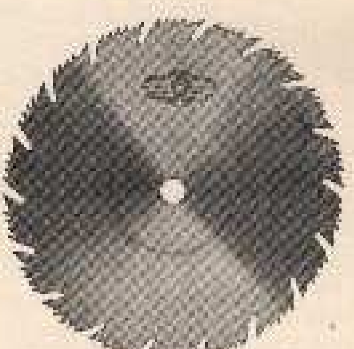


Fig. 181.—Combination Circular Saw.

of cut. One of the most popular saws for school use is the Novelty or Combination Circular Saw, which is designed to either cross-cut or rip, and which gives an unusually smooth cut.

Where the circular saw machine is of the one mandrel type the combination saw is just the type needed. As shown in the cut its teeth are made up in sections having small cross-cutting and one rip tooth.

The raker teeth are $\frac{1}{64}''$ lower than the cross-cut teeth and should be kept accordingly. This is the only necessary precaution the saw is as easily refitted as any circular saw. The smoothness of cut permits gluing without planing or sanding.

For school use order the 6, 8, 10, 12, or 14 inch diameters. Be sure to give correct center hole size.

Grooving or Dado Saws

Keystone Groover (or Dado Head) consists of two outside saws, each ⅛″ thick, and designed to give a smooth, square cut with, across, or mitre to the grain. With the addition of inside cutters provided with six teeth each and ⅛″, ¼″, or ½″ in thickness, grooves from ⅛″ to 2″ can be cut smoothly and easily. Notice from Fig. 182 how teeth of cutters can be distributed between outside saws to give uniform balance

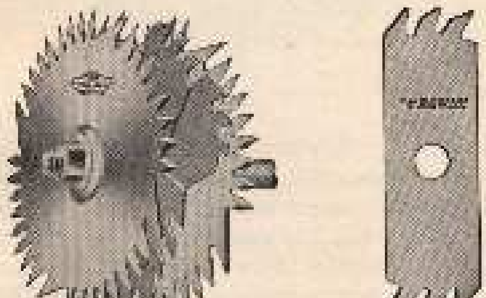


Fig. 182 – Keystone Groover or Dado Head.

and cutting to head, an improvement over the old-fashioned type having but two teeth to the cutter. The lance or mitre teeth of the outside saws and teeth of inside saws are gulleted to allow filing of ¼″ before regumming is necessary, a decided advantage to the busy instructor. This complete groover is furnished in the following sets, properly ordered by giving the following information:

(a) Diameter in inches of saw used.
(b) Mandrel hole diameter in inch.
(c) Number of set desired.

Set No. 1—Cuts grooves 1/8" to 1/2" inclusive.
2 outside saws, each 1/16" thick.
2 inside cutters, each 1/8" thick.
1 inside cutter, 1/8" thick.
1 inside cutter, 1/4" thick.

Set No. 2—Cuts grooves 1/8" to 3/4" inclusive.
2 outside saws, each 1/8" thick.
2 inside cutters, each 1/8" thick.
1 inside cutter, 1/8" thick.
1 inside cutter, 1/4" thick.

Set No. 3—Cuts grooves 1/4" to 1" inclusive.
2 outside saws, each 1/8" thick.
2 inside saws, each 1/8" thick.
1 inside saw, 1/8" thick.
2 inside saws, each 1/4" thick.

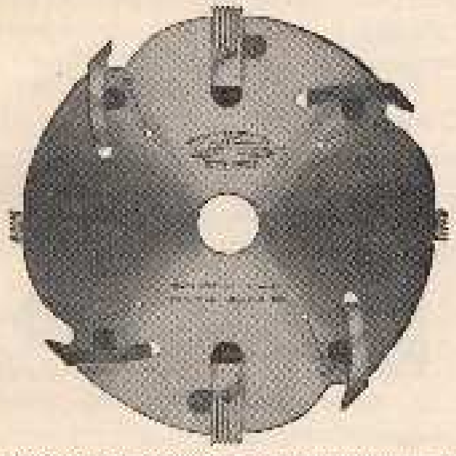
Set No. 4—Cuts grooves 1/4" to 1 1/4" inclusive.
Set No. 5—Cuts grooves 1/2" to 1 1/2" inclusive.
Set No. 6—Cuts grooves 1/2" to 1 3/4" inclusive.
Set No. 7—Cuts grooves 1/2" to 2" inclusive.

The Ideal Saw and Groover

The saw is regularly made in two thicknesses of plates, namely, 3/16 and 1/4 in. The thinner plate allows for the insertion of teeth which will cut from 5/16 to 1/2 in. kerf. The thicker plate allows for the insertion of teeth to cut 7/16 to 1 in. kerf. All teeth are made of "High-Speed Steel." These teeth are drawn into place by a wrench which engages notches on the concave edge of the teeth. Lock nuts, held by screws, then mesh and firmly hold the teeth in the same position in each socket. Teeth are easily and quickly changed.

As an extra locking precaution and to give set to the teeth, a spiral groove in the sockets receives a tongue on the back and front sides of the teeth, automatically giving them right and left set. This assures uniformity of kerf width and makes setting the teeth unnecessary.

The teeth are ground square or to the outline of any curve. In view of this, the operator, with the same saw, can run a dado, then easily change to moulding teeth, run a cove or ogee edge on a chest top, flute table legs, or run beading on stiles of desks. This saw can be used more safely than a shaper and will do the same type of work. A blue print of curves to which form teeth are made will be sent on request, or teeth will be made to fit template sent us.



No. 183.—A new and better Saw, combining in one tool a Groover, a Dado Head, and a Shaper.

For grooving or dadoing across or at an angle to grain, a special saw is required—one which has cross-cutting spurs inserted in the saw rim. Be sure to specify that cutting will be done across or at angles to the grain.

The use of High-Speed Steel teeth increase the life of the cutting edge. As the teeth wear, they are moved out one notch each, thus both the diameter of the saw and the set can be kept constant without any complicated adjustments.

This tool fills a long-felt need in the school shop having a circular saw, but having no suitable machine for doing moulding and fluting, grooving or dadoing.

In ordering the Disston Ideal Saw give:

1. Diameter of saw in inches.

2. Size of mandrel hole.
3. Range of grooves desired—$\frac{3}{16}$ to $\frac{3}{4}$ in. or $\frac{1}{16}$ to 1 in.
4. Sets of extra teeth desired in range of grooves selected (available by $\frac{1}{16}$ in.).
5. Whether 4 or 6 teeth desired.
6. If saw will require cross-cut spurs.
7. Number of sets of extra moulding teeth desired.
8. Shape or form of moulding teeth. (Send paper template of cut to be made.)
9. If formed teeth having high and low sides are required, state if high side is toward mandrel pulley or away from it when the saw is running toward the operator.

Tools for Swaging Circular Saws

In recommending our Conqueror Swage for use in school shops we call attention to the fact that this swage is not solid, but slotted, assuring that the keen edge of the tooth is not destroyed, and that the top groove spreads tooth, while the lower squares and finishes it.

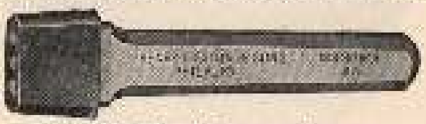


Fig. 184.—No. 2½ Conqueror Swage.

No. 2½ Conqueror.—This size is particularly well adapted for the type and diameter of rip saws usually used in school woodworking shops.

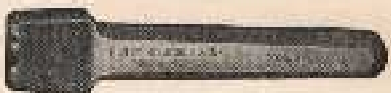


Fig. 185.—No. 3 Conqueror Swage.

No. 3 Conqueror.—For saws of 6", 8", and 10" diameter rip saws where it is desired to use swage rather than spring set.

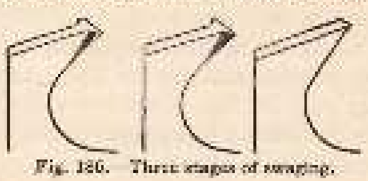


Fig. 186. Three stages of swaging.

Tools for Setting Circular Saws

To assure setting the teeth of a circular saw evenly so that the saw "tracks" or runs even, requires considerable skill unless the operator secures the assistance of the proper setting tools.

Improved Adjustable Setting Stake.—This stake is for saws from 6 to 30 inches in diameter. The cone A is moved in or out until the saw rests on the anvil B, its teeth projecting only as far over the

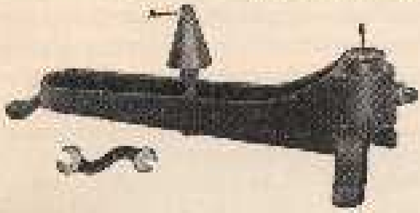


Fig. 187.—Setting stake for circular saws.

bevel as required to conform with the set given the teeth at the factory. The anvil can be rotated to use narrow or wider faces of the bevel, and the block can be reversed in its socket after becoming worn. The amount of set can be definitely regulated, and this stake will assure even and satisfactory set to all teeth.

Hand Machine for Setting Circular Saws.—In shops where the production method is being followed, and the volume of work performed by circular saws requires considerable setting we recommend

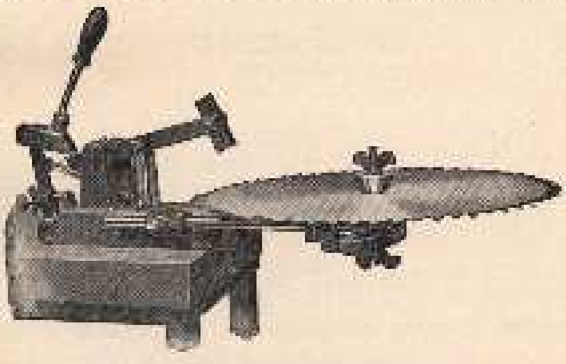


Fig. 188.—Setting machine for circular saws.

this machine, adjustable to saw from 5" to 24" in diameter. The force of the hammer blow can be adjusted to suit gauge of saw, all blows are of same weight, so that set is uniform. This is the best machine of its kind built.

Disston Machine Knives

For complete information on machine knives of all types see pages 129 to 137. For planer, jointer, moulder, shaper you will find that Disston Steel knives are more accurately ground and balanced, and have the paramount advantage of holding their cutting edge longer. In ordering give length, width, and thickness in inches, and specify kind of steel

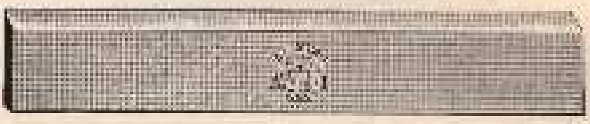


Fig. 188.—High-speed Steel Knife.

desired. If your knives are slotted, send a proper template giving outline of knife, bevel face up. Unless otherwise specified both our high-speed and carbon knives are ground to 30 degrees, flat bevel. In ordering your new machinery always specify "equipped with Disston A1 High-speed Knives," thus assuring yourself the best. Or, if your present machines do not cut smoothly, re-equip them with our A1 high-speed knives and see the high glazed finish on your planing and jointing work.

Saw Repair Service

Tools made of Disston Steel last many years, and due to this length of service and our desire to have our tools give full satisfaction, we maintain a repair department. It is well for you to remember the many facilities thus made available to you for putting your saws into first-class operating condition. During vacations send your saws to us for refitting. Carefully pack your saws so that the handles will be protected and the blades kept from bending. Mark your shipment plainly, and be sure to add your return address. Inside the box enclose a list of the saws sent and any directions you want followed relative to replacing missing screws, or recutting teeth on certain saws. Advise us by mail at same time of your shipment.

Hand Saws.—We have special workmen assigned to each of the following services:

1. Set and file (includes jointing).
2. Shear off old teeth, retooth, set, and file. Change teeth to any size or type if desired.
3. Replace broken handle, replace screws missing from handle.
4. Retension blade.

Narrow Band Saws

1. Set and file.
2. Braze.
3. Straighten and retension.

Circular Saws

1. File.
2. Swage or spring set.
3. Cut new teeth any spacing, any style.
4. Increase size of mandrel hole.
5. Retension, hammering.
6. Grind to gauge.

Machine Knives

1. Sharpen.

We will be glad to have your inquiry for prices on our repair work either at Philadelphia or at our branch factories.

Hand Saw Repair Tools

Saw Pieces for Practice Filing. These pieces are made of saw-steel cut to sections 2½ by 6 inches, and toothed with either rip or cross-cut teeth on one edge. In a dozen assorted pieces are included

Fig. 190.—Practice Filing Piece.

the usual points of teeth. The teeth on these blades have neither been set nor filed. The temper is slightly below that of regular saw blades, and they are ideal for practicing both setting and filing. They are almost indispensable if you teach filing.

Star Saw-set.—An inexpensive tool for setting hand, back, narrow

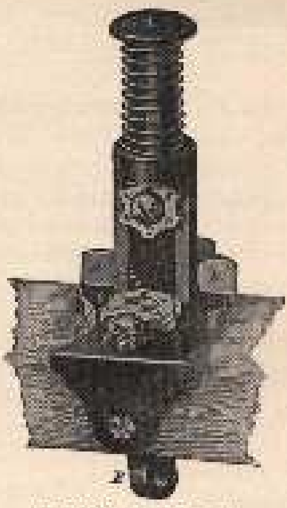


Fig. 191.—Star Saw-set.

band, web, and small circular saws up to 8" diameter (18 gauge). (See Fig. 191.)

Triumph Saw-set.—The most ingenious and effective saw-set made. There are two plungers brought into operation by pressure on the handles.

The first or lower plunger clamps the saw blade against the anvil of the set, allowing the top plunger to be centered on the tooth and preventing any backing off while tooth is being set. The winged flanges shown at B rest on the teeth on either side of the one being set, and control the depth at which the top plunger bears on the face of the tooth. Continued pressure on the handle causes the top plunger to press the top of the tooth being set until it is flush with the bevel of the anvil. The saw is held easily under the arm during setting, the plunger fits the hand, and this natural position is the least tiring of any that could be assumed. In using the Triumph find the proper amount of set by comparing one of the four bevels on the anvil with teeth near the heel of the saw. Also turn the nut A to have the winged flanges B allow only the upper half of the tooth to be bent by the plunger giving the necessary set. The

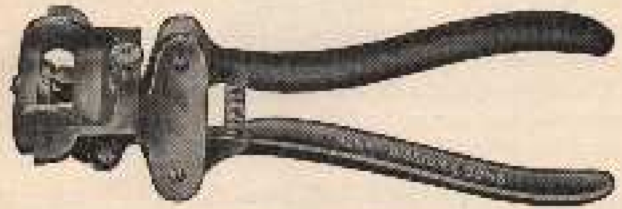


Fig. 192.—Triumph Saw-set.

tendency of most saw sets is to spring more than half the tooth, thus warping the blade or breaking out the tooth. In short, this saw-set, designed and perfected by saw makers, furnishes you the most reliable tool of its kind for your school shop.

No. 28.—For hand saws and narrow band saws.

No. 280.—For saws of nine or more teeth per inch. Especially for back saws.

No. 18.—For fine point circular saws, not over 14 gauge.

Hand Saw Jointer. Before sharpening the teeth it becomes necessary to joint the tooth, that is, to reduce them to an even height, or, as it is usually called, "dress them down." While this can be done by running a file along the edge, this method of jointing may cause the teeth on one side of the set to be shorter, resulting in the saw running in or out from a straight line. To obviate this we recommend the Disston Jointer, which assures evenness of height on both sides of the set. Simple in construction, readily adjusted, and easily and quickly operated. This jointer is made to

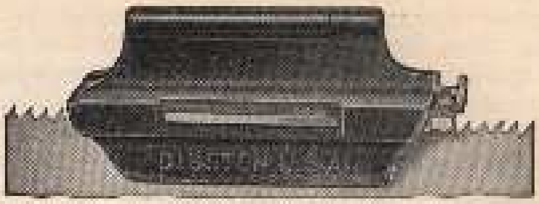


Fig. 193.—Hand Saw Jointer in use.

fit over and to hold a file in proper position for jointing the tooth edge of a saw. The sides of the jointer bear against the sides of the saw blade and hold the file in proper position. File is furnished with jointer and is removable.

Saw Filing Guide, D-3.—As the cut illustrates, this is both a saw clamp and filing guide. The file is fastened in the handle, which has a guide rod sliding freely in the ways of the swivel head. There are marks on the swivel head to indicate the proper angle for filing cross cut and rip teeth. Use of the guide assists in getting proper and uniform bevel on each tooth, enabling one unfamiliar with the art of saw filing to perform a commendable job of filing. Your pupils need this saw filing aid.

Fig. 194.—D-3 Saw Filing Guide and Clamp.

To use the guide select a tooth of correct shape, usually located near the heel of the saw, let the file down into the groove, then tighten the set screw, file a tooth, and see if the shape suits. If not, turn the file a little to the right or left and try another tooth. When proper shape is obtained, file every other tooth, or those set toward the operator. When one side is finished, reverse the saw and attachment and file the other teeth.

The jaws are 12½" long. Set includes Clamp, Filing Guide, 5½" Disston Slim Taper File, and File Handle.

Saw Clamps.—One of the important factors in jointing, setting, and filing a saw is a firm clamp for holding the blade of the saw. A poor holding device will detract from the most careful work.

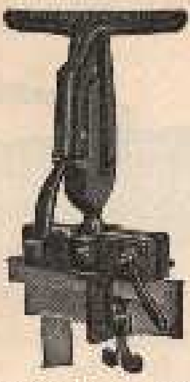


Fig. 195.—Adjustable Saw Clamp, No. 1.

Nos. 1 and 2 (Improved).—These are positive locking clamps, allowing the blade to be held close up to the bottom of the teeth. The first has a 9" jaw, the second a 9½". The No. 1 has a ball and socket joint at the bench, permitting it to be held firmly at any angle. The No. 2 has a wing nut adjustment at the bench, allowing it to be tilted forward or backward.

Fig. 196.—Adjustable Band Saw Clamp No. 4.

Adjustable No. 4.—For narrow bands and web saw blades. Arms are adjustable for various widths of blades. After finishing one section, the clamp is released and the blade slid along. Quick operating, positive in action.

Handy, No. 5 and No. 6.—The blade can be quickly inserted into the clamp and the eccentric handle assures quick contact with entire length of blade.

No. 5 is fastened to bench by screws, No. 6, by screw lugs. Designed to be light in weight and convenient for carrying in tool kit.

Fig. 197.—Handy Saw Clamp No. 5.

Handles.—Since each handle on a Disston saw was separately hung to its blade before being fitted to the blade, it is recommended that in ordering handles for replacing those accidentally broken you specify, "SLIT ONLY." Be sure to give the type of saw (see number etched on every blade, as D-8, No. 7, etc.) and length of blade, as 22", 26", etc.

To put on the handle, fit the slitted handle over the old blade, so that the handle occupies the position of the former handle. Scribe around

Hand. Back. Compass.

Fig. 198.—Various types of Saw Handles.

new handle on blade. Remove blade from slit, and place it on left side of handle, using scribed lines to assure correct position. Mark holes to be bored on handle. Bore and countersink hole. Put handle on blade. If countersink holes do not allow heads to come flush, counter bore them until correct fitting is secured.

Kind of wood need not be specified. In all cases, standard for the type of saw is furnished.

Saw Screws.—In ordering brass screws for handles, give the type of saw (the number etched on the blade) and the length. These sets of screws are standard for different saws and are not always interchangeable.

No. 1 No. 2 No. 4

Fig. 199.—Types of Saw Handle Screws.

Trade No.	Length	Type of Screws
D-8	24 inches and under	Three No. 1, one No. 3
	26"	Three No. 2, one No. 1, one No. 4
No. 7	22"	Two No. 14, one No. 3
	24"	Three No. 14, one No. 3
	26"	Three No. 15, one No. 4
Back Saw No. 4 Back Saw No. 9 Half Back Bench Saw No. 8		Two No. 0, one No. 3
Mitre Box Saw No. 4	18, 20, 22 inch	Two No. 0, one No. 3
	24, 26, 28, 30 (4" wide)	Two No. 2, one No. 4
	22, 24, 26, 28, 30, 32 (5" wide)	Three No. 2, one No. 4
Jackson Back Saw No. 1	8, 10, 12 inch	One No. 08, one No. 20
	14, 16, 18 inch	Two No. 08, one No. 20
Compass No. 2		One No. 1, one No. 3
Compass No. 77		One No. 1, one No. 3
Dovetail No. 70		Two No. 00
Joiner		One No. 1, one No. 3
Keyhole No. 15		Two No. 08 short (5/8" long)
Patternmakers'		Two No. 1 extra short

Files and Rasps

(See also pages 106 to 115)

A hasty examination of two files would not show you which is the better. To assist you may we point out some tests readily applicable to this tool? In the first place, the best steel is required to make good files. Disston Files are made of the famous Disston Steel. After this metal is rolled, sectioned, tanged, and annealed, the blanks are carefully ground to remove the oxidized surface and make their surface even. If this operation is carelessly done, the cutting surface later set up will have imperfections, the file will be irregular in its cutting, and the teeth only partially formed in the "low" areas. The surface is now stripped, that is, the glaze is removed from the surface to assure proper action by the cutting chisel. In the most modern file cutting machines the teeth are now cut, one file at a time, in order that each tooth will be perfectly formed. Closely examine the teeth for regularity and you will begin to appreciate that all files do not look alike. After teeth are cut, the files are rigidly examined and any with imperfections are thrown out. All files that bear the Disston name are first-quality, rigidly inspected files. The files are then coated with a paste over the fine points of the teeth in order to protect them during the hardening process. This is a precaution that further assures a good cutting edge on each tooth. When the file is put into the lead bath the covering remains to shield the thin metal edge. The file is cleaned, again inspected, and oiled, when it is ready for use.

The real test of a file is its cutting, and when a Disston taper file is lowered into the notch of a saw and pressed downward and forward, the file can be felt taking hold and removing the metal from the saw teeth. Also when one of the bench files, such as a Flat Bastard File, is cutting the steel surface of a block, the even, smooth filing is the final proof that Disston files are made to provide you with real filing service.

Files for Metal Working (Common Bench Types)

Flat.—One of the most widely used type of metal working files. Tapered in width and thickness, sometimes made blunt. Double cut, with edges single cut. Can be ordered in any grade cut from rough to dead smooth, bastard being most common.

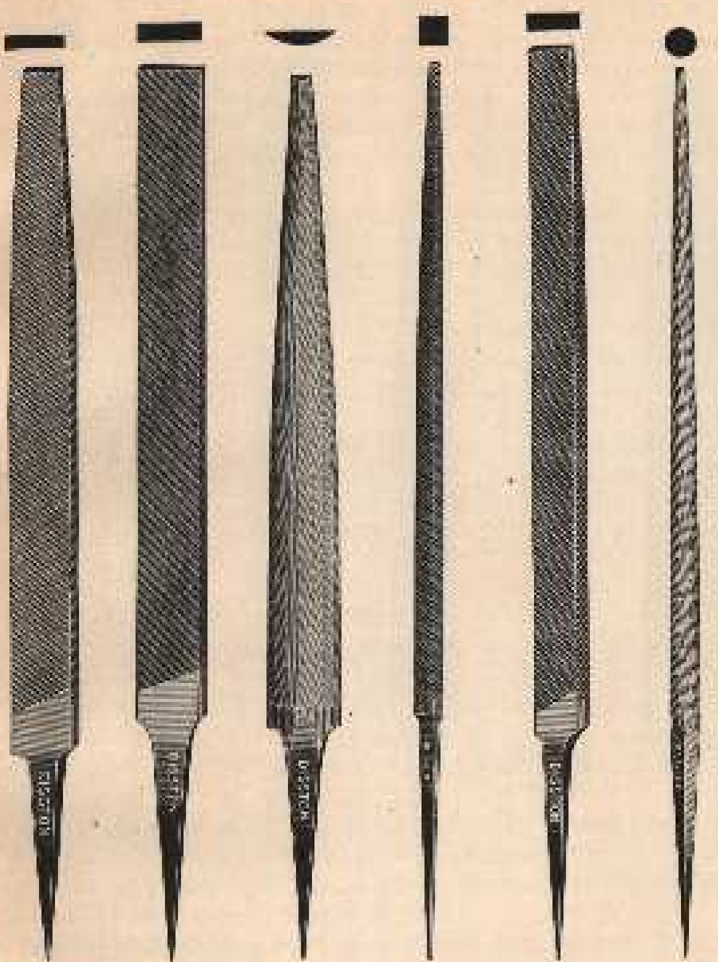


Fig. 200. Fig. 201. Fig. 202. Fig. 203. Fig. 204. Fig. 205.

Fig. 200.—Flat File.
Fig. 201.—Hand File.
Fig. 202.—Half-round File.

Fig. 203.—Square File.
Fig. 204.—Pillar File.
Fig. 205.—Round File.

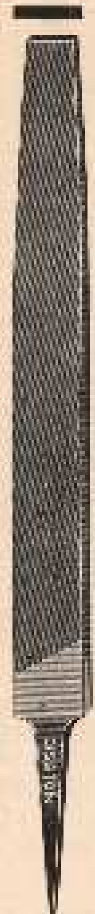


Fig. 206.

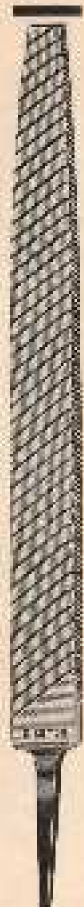


Fig. 207.

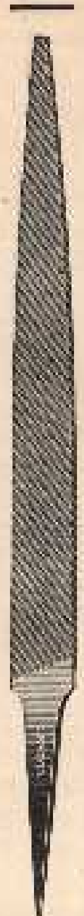


Fig. 208.

Fig. 209.

Fig. 210.

Fig. 211.

Fig. 206.—Mill File.
Fig. 207.—Perfection Shear Tooth File.
Fig. 208.—Warding File.

Fig. 209.—Lathe cut File.
Fig. 210.—Half-round File for solder.
Fig. 211.—Flat Aluminum File.

Hand.—Used for finishing flat surfaces. Parallel in width, tapered in thickness from two-thirds length to point. Double cut, with one edge "safe" or uncut. Can be ordered in any cut from rough to dead smooth, second and bastard being most commonly used.

Half-round.—For general machine work. Tapered in last third, but can be ordered blunt. Double cut. Can be secured in any grade from rough to dead smooth.

Square.—For filing apertures or dressing out square corners. Tapered, but can be ordered blunt. Generally double cut. Can be secured in any cut from rough to dead smooth. Most common are second cut and bastard.

Pillar.—Used on narrow work, cutting grooves for cotters, keys, or wedges. Parallel in width, same general shape as hand file, not as wide, but same thickness. Double cut. Bastard, second cut, and smooth are usual cuts.

Round.—For gulleting, enlarging holes, and small radius curves. Tapered, but for machine shop the blunt form is more practical. Double cut. Usual cuts are bastard, second, and smooth.

All common bench files are available in 6, 7, 8, 9, 10, 12, 14, 16, and 18-inch lengths.

Files for Metal Working (Lathe and Special Types)

Mill.—Lathe work, draw filing, finishing. Tapered in width and thickness. Single cut. Can be ordered in any cut from rough to dead smooth. Also used for sharpening machine knives, circular saws, etc.

Perfection Shear—Flat.—Lathe work; quick smooth work. Teeth at steeper angle, wider spaced, coarser. Same shape as flat file. Also used for quick cut on soft steel, iron, and brass castings. Note: Almost any type of file can be secured with shear teeth.

Warding.—Slotting work by machinists and jewelers. Tapered in width, very thin. Double cut. Available in bastard, second, and smooth cuts.

New Angle or Lathe Cut.—Lathe work. Double cut, first or "up" cut is almost straight across, while over cut is a long or steep angle, making the file practically a self-cleaner.

Half-round for Solder.—For soft metals. Special open cut.

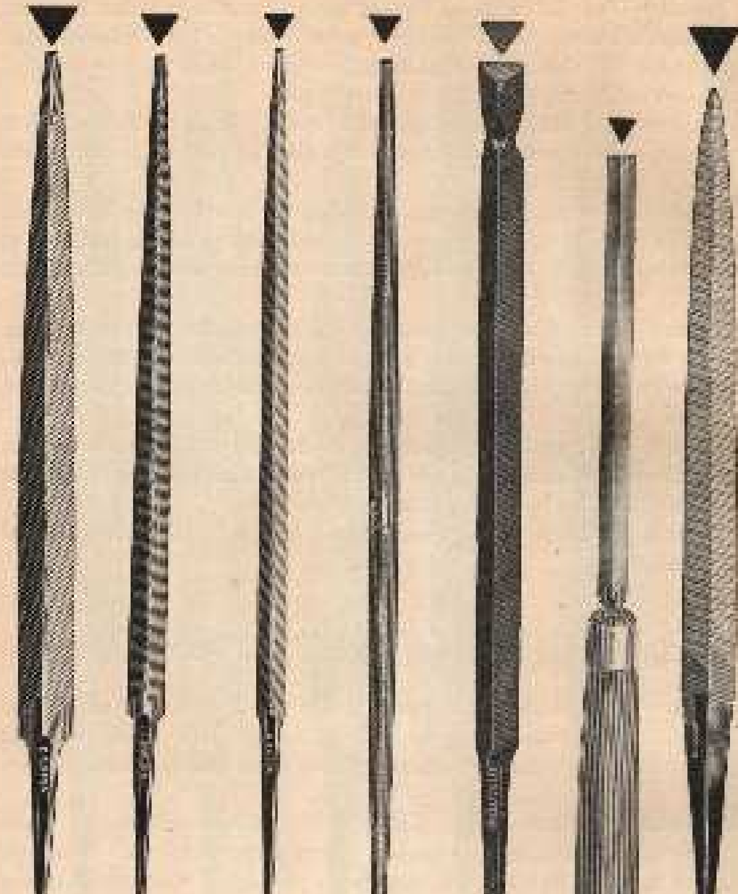


Fig. 212. Fig. 213. Fig. 214. Fig. 215. Fig. 216. Fig. 217. Fig. 218.

Fig. 212.—Regular Taper File.
Fig. 213.—Slim Taper File.
Fig. 214.—Extra Slim Taper File.
Fig. 215.—Double-end Taper File.

Fig. 216.—Little Wonder Saw File.
Fig. 217.—Hunt's Chrome Special Square File.
Fig. 218.—Stubb's Pattern File.

Flat Aluminum File.—For work on aluminum. Teeth of special design.

To show the great variety of types:

Special files for
- Die-sinking,
- Clockmaking,
- Silversmithing,
- Shoemaking,
- Cotton ginning,
- Beet shredding.

All lathe and special files are available in 6, 7, 8, 9, 10, 12, 14, 16, and 18 inch lengths.

Files for Saw Filing (Hand and Back Saw Types)

Taper Files.—Single cut, edges rounded, to assure that the gullets of the teeth are properly formed. Fineness of teeth is always "second cut." Lengths available are 4, 5, 5½, 6, 7, 8 inches. As to size of cross-section, these files range from large to small, as follows: Regular, Slim, Extra Slim, as shown in Figs. 212-214. The slim taper is fine enough for back saws, but some filers order either the extra slim or double slim for this purpose.

The reversible taper saw file is preferred by the filer who wants a longer file and appreciates the advantage of getting two files in one. Lengths are 7, 8, 9, and 10 inches. Slightly smaller in cross section than the slim taper file.

The Little Wonder Saw File is made the same cross-section throughout, or blunt, and is provided with a thumb rest on the end which makes it easier to hold. It is the same cross-section as the largest portion of the slim taper. Sizes are 4, 5, 5½, and 6 inches.

Hunt's Chrome Special Three Square File is a blunt saw file of the extra slim taper cross-section particularly adapted for filing fine toothed saws. Sizes 4, 5, 5½, and 6 inches.

Stubb's Pattern Double Cut Saw File is similar to the regular taper file and adapted for high temper saws, hack saw and power saw blades. Sizes same as regular taper.

Blunt Saw File is adapted for those preferring this design of saw file. It is otherwise identical to the regular taper file.

Climax File is made only in 6-inch lengths for filing wood saw blades of special shape.

Cant Safe Back File is adapted to filing special wood saw teeth such as patternmakers' saws, lance point teeth, mitre teeth, or wood saw blades. Also for filing Novelty or Combination Circular Saws, and those with mitre teeth. A single cut file, with "second cut" spacing. Length, 6".

Cant or Lighting File is the same as above, but cut on all sides. Size 8 inches.

Band Saw Files.—Files for this purpose are similar to those for hand saws except they are usually ordered in somewhat larger sizes. The edges are rounded more to assure proper gullets, and the files are made in either regular or slim taper in blunt or taper. Sizes are 4, 5, 6, 7, and 8 inches.

Machine Band Saw Files are made blunt, without tang, otherwise identical to band saw files. Size 4½ inches.

Circular Saw Files. Mill Files, as previously stated, are of single cut, taper in length and width, used for sharpening circular saws and planer knives. Usual cuts are bastard, second cut, and smooth. Sizes 6, 7, 8, 10, and 12 inches.

Blunt Mill File. Single cut, bastard, or second cut for those who prefer this type. Sizes same as above.

Mill File Round Edge.—The use of the round edge prevents formation of sharp corners or edges in the gullets, thus reducing the possibility of cracking. Can be furnished with one or both edges rounded, as desired. Cuts bastard, second, and smooth lengths same as above.

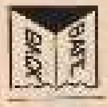
Mill File Narrow Point. Preferred by certain filers for smaller tooth saws. Sizes and cuts same as above.

Round File for gumming the teeth of circular saws. Tapered in length. An 8, 10, or 12-inch len th is suitable for this work.

Files for Woodworking

Files for Woodworking Shops.—Due to the fibrous nature of the material to be cut files for wood have larger and more widely separated teeth. The types illustrated are usually ordered in 8, 10, or 12-inch lengths for school shops. (See page 204).

Rasps for Woodworking Shops. Instead of being chisel cut, rasp teeth are raised with a punch. The teeth are higher, set farther apart, and staggered. Due to this construction they cut uniformly, but rapidly.



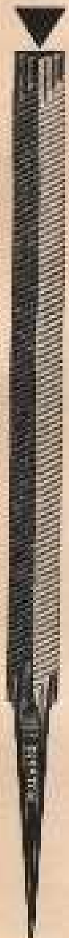


Fig. 219.

Fig. 220.

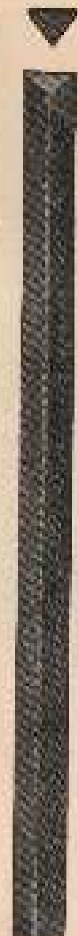
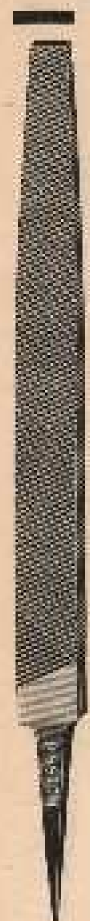
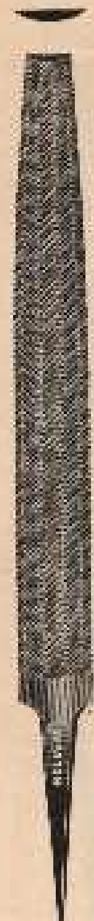
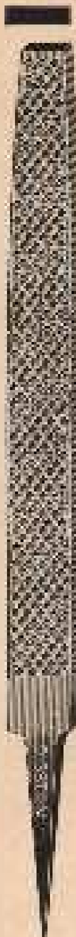


Fig. 221.

Fig. 222.

Fig. 223.

Fig. 219.—Blunt Saw File.
Fig. 220.—Climax File.
Fig. 221.—Machine Band Saw File.
Fig. 222.—Mill Saw File.
Fig. 223.—Cant Safe Back Saw File.

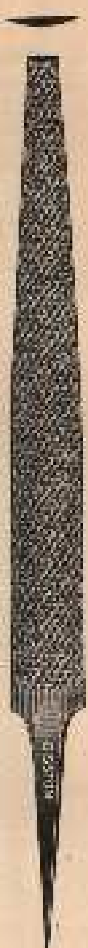



Fig. 224. Fig. 225. Fig. 226. Fig. 227. Fig. 228. Fig. 229.

Fig. 224.—Flat Wood File.
Fig. 225.—Cabinet File.
Fig. 226.—Flat Wood Rasp.

Fig. 227.—Half-round Wood Rasp.
Fig. 228.—Half-round Cabinet Rasp.
Fig. 229.—Round Wood Rasp.

The types illustrated should be ordered in 8 to 12-inch lengths. We especially recommend the fine-toothed cabinet rasp. Its narrow blade permits working re-entrant curves to a smooth finish. The round wood rasp is also convenient for interior work.

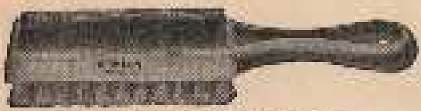
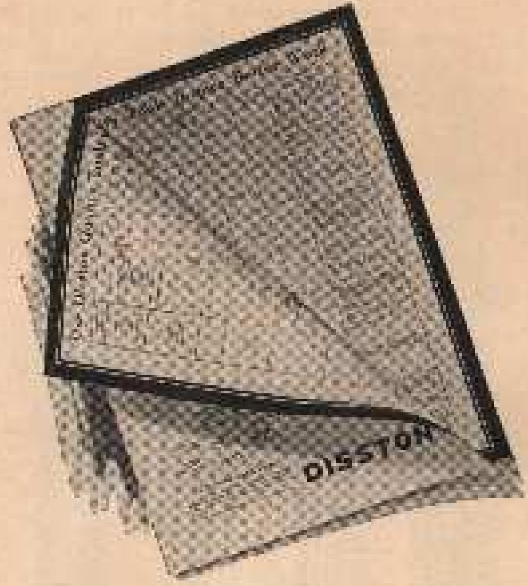


Fig. 330.—File Card and Brush.

This combination card of wire bristles and fibre bristles permits of first loosening the filings and then cleaning them with brush. Although not generally known, a file requires this attention to assure best results. Get a few of these inexpensive cards and brushes and lengthen the life of your files.



Specification Folders

Our specification folder is a convenient record for jotting down your tool needs as they arise in the school shop. It presents concisely the essential information of size, style, and order number of Disston school tools.

To use this sheet, as need for an item arises, write the number desired in the space provided, draw a circle around the size and type preferred.

This data is convenient when you assemble your requisitions. In fact, a typist can make up your specifications directly from this sheet. It systematizes your requisitioning as it does away with a lot of loose slips of paper which become mislaid or lost.

If you have not received a copy of this sheet let us send it at once. Or, perhaps having used it, you now would like extra copies for yourself or other instructors. We will gladly send single copies or quantities at your request.

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