CARE OF WOODWORKING TOOLS AND EQUIPMENT

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Several instructions sheets prepared by Dr. DeWitt Hunt, Cliff Tinkle, L. Stephenson, R. Smith, J. Chumley, Oliver Machinery Company, and Henry Disston and Sons, Incorporated were used in this report.

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Chapter I

THE PROBLEM AND DEFINITIONS OF TERMS USED

Along with the development of tools has come the development of methods of how to sharpen tools. A good tool deserves good treatment and the more care it can be given the better quality the work that will result from its use. The quality of work produced by a craftsman is not altogether due to his skill in handling the tool, but also is influenced by the condition the tool is in when used. "The ability to sharpen tools properly is the first requisite of anyone aspiring to become a woodworker. It always pays to take time to sharpen tools, both from the standpoint of performance, as well as actual time saved in the execution of the work." (A-11, page 106) Care of woodworking tool and equipment is a determining factor in how well a student will complete a project in the school shop.

The Need For The Study. For some time the writer has been observing in touring various shops, especially the condition of woodworking tools and equipment and how poorly they have been taken care of by those who use them. This problem was suggested when the writer noted the lack of care and the carelessness in the sharpening of woodworking tools and equipment found in the school shops. It would seem then that there is a definite need of special instruction in the conditioning of woodworking tools and equipment.

The Purpose and Statement of the Problem. The purposes of this report are: (1) to describe the procedure and tools required for conditioning some of the more essential woodworking tools and equipment and (2) to create an interest among those who are connected with the woodworking program so that there will be a better organized plan of teaching "Care of Woodworking Tools and Equipment" in industrial arts courses.

In this report an attempt has been made to give also a better understanding of the development of hand tools from prehistoric to current times. The writer has chosen to show the development of the file and saw because more information seemed available for these two tools and perhaps they are the oldest tools known to man.

Techniques Used in This Study. Considerable historical research was required to write Chapter III. Through a study of books found in the library on history of the ancient times some material was found. Free literature published by two leading manufacturers, Disston and Nicholson, also provided some information used.

The survey method was used in two instances. One when letters were written to each of the five leading file manufacturers, Atkins, Delta, Disston, Nicholson and Simonds, for information on sizes of triangular tapered files and another when a letter was written the Oliver Machinery Company for information concerning the band saw brazer.

Information has also been secured from other free literature published by various reliable companies such as Stanley, Norton, Cleveland Twist Drill Company and others. This literature was requested by Dr. DeWitt Hunt, Head of Industrial Arts Department, Oklahoma A. & M. College, and was distributed among those in his classes. Valuable information was also received by the writer in other classes he attended while taking work at Oklahoma A. & M. College.

Delimitations of Terms. The word "tools" as used in this report, is limited by definition to:

> those hand tools which would be most likely to be found in a woodworking shop, regardless of size, and which require constant care or sharpening because of wear resulting from normal use.

"Equipment in this report is limited by definition to:

equipment used to maintain the tools above mentioned and also the accessories used on the most common machines, namely the circular and band saw.

Glossary of Terms Used in "Care of Woodworking Tools and Equipment."

The definitions which follow have been developed by succeeding classes in the course "Care of Shop Equipment" as it has been offered in the Department of Industrial Arts and Engineering Shopwork at the Oklahoma A. and M. College. When quoted, the source of the definition is shown in the right hand column.

TERM	DEFINITION	BY WHOM
Alemite	A Type of grease plug to insert into a machine which makes it possible to use a pressure grease gun.	
Annealing	Conditioning the steel.	
	Retempering of a band saw blade at the point where it has been brazed.	Disston
	To break down crystals of steel from a coarse, formless, jumbled mass to a uniform texture by a heat treatment.	Nicholson
Arbor	The spindle or axle of a wheel.	
	The spindle to which a circular saw is secured to the machine.	Disston
	The center of revolution.	Disston
	The spindle of the grinding machine on which a wheel is mounted.	Norton
Bevel	The angle which one surface makes with another when not at right angles.	
	The angle ground or filed on a cutting instrument to give back clearence.	Disston
Bonds	The fastening together of the particles as in grinding wheels.	Norton
Brights	A surface which reflects light. The flat top of saw teeth after jointing. Same as flats	

TERM	DEFINITION	BY WHOM
Cams	A device mounted on a revolving shaft used for transposing rotary motion into alternating, reciprocation or back and forth motion.	
	Fingers on a saw filing machine to move saw.	Disston
Clearance, angle of	The angle of the top of rip saw tooth, tops of jointer knives, shaper knives, etc.	
Combination saw	A saw used for cutting across the grain or with the grain of the wood. It has two, three or four cross-cut teeth for each rip tooth.	
	A saw consisting of cross-cut and rip teeth used for cross cutting, ripping, or mitering.	Disston
Cross-cut saw	A saw used for cutting across the grain of the wood.	
	A saw consisting of cutter teeth used for cutting across the grain of wood.	Disston
Cutters	The inside cutters of a dado head.	
	Inside cutters of a dado head having various thickness usually 1/16", 1/8" or 1/4".	Disston
	Inside plates or spacers of dado head.	Huthers
Cutter head	A device in which may be fastened cutter knives. When assembled they are called cutter heads. May be used on any rotary cutter machine.	Disston
Dado	Two outside cutters and any number of inside cutters fasten together to do a special job.	
	Consist of two outside saws 1/8" in thickness and any number of inside cutters, width of 1/16", 1/8", 1/4".	Disston
	A dado head consist of two outside saws together with one or more fillers.	Simonds
Dies	The hardened metal faces in a swage. Used for swaging saw.	Huther

TERM	DEFINITIONS	BY WHOM
Face	A side or surface of anything	
	The front of a saw tooth.	Huther
	That part of a surface straight wheel on which surface grinding is done.	Norton
Facet	A very small surface such as one of the surfaces of a diamond.	
	A surface on an irregularly filed saw tooth.	Hunt
Flute	The grooves of a twist drill or tap.	Norton
	Two spiral grooves running along opposite sides of the drill.	Cleveland
Ferrule	The metal band on one end of a handle for file, chisel, etc. To prevent from splitting.	
	The end of the handle that the tang of the file fits into. May be coiled spring to prevent it from splitting.	Disston
Gauge	A standard of measurement for wire and sheet metal.	
	A standard of measurement for thickness of saws.	Disston
	A tool used to measure thickness of saws. (Stubbs gauge)	Huther
Glazing	Filling up of the interstices of the surfaces of a grind stone or emery wheel with minute abraded particles detached in grinding.	Norton
Gullet	The throat; the esophagus.	
	The space between the teeth of a saw. The dust chamber.	Atkins
	A rounded throat between the teeth of a saw.	Disston
Gumming	The removing of metal in the gullet to lengthen the tooth as in a saw.	

TERM	DEFINITION	BY WHOM
Gumming	Removing of nicks or sharp corners in the gullet with a round file or emery wheel.	Disston
	Saw sharpening and shaping with a grinding wheel.	Norton
	Grinding the gullet deeper with an emery wheel.	Norton
Heel	That opposite the point or toe. The back or cutting edge of a skew.	
	The portion of a cutter back of the lips or cutting edge.	
Hollow ground	A surface that has been ground for clearance.	
	Grinding away of metal on both sides of a circular saw to prevent binding.	Disston
	Ground for side clearance.	Huther
Hook	The shape of the band saw tooth, usually hooked or under cut.	Disston
	When saw has less angle at the front of the tooth than those recommended it is said to have more hook or pitch.	Disston
	A line along the face of rip saw tooth will pass half way between the center and the rim of a circular saw.	Simonds
Joint	To make the tops of the teeth an equal height.	Nicholson
	To make all teeth the same height. To make a circular saw round.	Disston
	An operation to insure that all teeth are cutting in a perfect circle. Bring all teeth to the same height.	Huther
Kerf	The area removed when using a saw. The width of the saw plus the set of the saw.	
Lip	The part which lifts out the material as in an auger bit.	
	The cutting edges of a drill that part of the auger bit that follows the spur and cuts	

TERM	DEFINITION	BY WHOM
	the chips.	Cleveland
Mill file	A single cut file used with light pressure to produce a smooth surface on metal. Usually used in filing rip saws.	Nicholson
Miter saw	A combination saw with six or more cross-cut teeth for each rip tooth.	
Nicks	Irregularities in the straight line or cutting edge of a sharpened tool.	
Point	The tapering end of anything pointed.	
	The front end of a file or saw.	Nicholson
	The cone-shape surface at the cutting end is called point.	Cleveland
Protractor	A tool used for measuring angles.	
Rake angle	An angle between the top or cutting surface of a tool and a plane perpendicular to the surface of the work.	
	The angle of the flute in relation to the work.	Cleveland
Raker tooth	A tooth to free the kerf from the dust or shavings that are severed by the cutting tooth.	Atkins
	Teeth to clear out the cut.	Nicholson
	The raker or cleaner removes the section left by the cutters.	Disston
Rip-saw	A saw consisting of chisel like points used for ripping with the grain of the wood.	Huther
Scarfed	Feathering or tapering the ends of the band saw before brazing together.	Atkins
	Filing a true taper where the saw is joined.	Disston
Set	To put in readiness as to adjust the teeth of a saw.	
	To bend teeth of saw slightly and uniformily	

TERM	DEFINITIONS	BY WHOM
	so that width of cut made by saw will be wider than the saw itself.	Nicholson
Shank	That part of the bit that fits into the chuck of the brace.	Irwin
	The end of the drill that fits into the drill press.	Cleveland
Side clearance	The distance from one edge of the kerf to the saw, to prevent binding.	
	Clearance to prevent binding or heating.	Disston
	Ground from rim toward center to decrease thickness.	Huther
Spur	That portion of the auger bit that scores the outer edge of the hole.	Irwin
Swage	Tool used to form a saw tooth into a good chisel shape needed for ripping.	Atkins
Swaging	To shape tooth by means of a swage.	Atkins
	To shape tooth of saw for side clearance	Disston
Tang	A projecting shank prong, or tongue, as on a knife, fork, file or chisel, to connect with the handle.	
	Is a portion of the tool which fits into a slot in the socket or spindle.	Cleveland
	The narrow portion of a file which engages the handle.	Nicholson
Template	A jig or pattern used to check work.	
Throat	That part of an auger bit that receives the chips from the lips and conveys them into the twist.	
Twist	That part of an auger bit that receives the chips from the throat and conveys them to the mouth of the hole.	Irwin
Ways	That which a sliding table runs on as in bench saw.	
	The surface on which a carriage slides when machine is operation.	Disston

TERM	DEFINITION	BY WHOM
Web	The web is the back-bone or supporting section of a drill.	Cleveland
Whetting	The act of whetting or sharpening on a fine stone.	
Wire edge	A turned rough metal edge left on the cutting edge after grinding or filing.	
Zerk	An attachment used on machine for the use of a gun for greasing.	

A careful study has been made of the equipment and procedure necessary for conditioning the tools mentioned in this report. The selection of this equipment and the procedure used in each case are not just the writers ideas but are documented and referred to those authors who are experienced in the care of woodworking tools and equipment.

Chapter II

PHILOSOPHY OF INDUSTRIAL ARTS

Before a definite idea can be formulated, there must first be a definition of terms to be used pertaining to the subject to be discussed. Education, in general, is "the developing of a happy, useful, and successful citizen." (A-22, page 50) There seems to be no better way to express an educational philosophy than in form of aims and objectives. It would seem possible to state these aims and objectives in perhaps three general divisions such as (1) a standard or goal to be achieved; (2) the end toward which the activity is directed; and (3) the desired change to be expected in the student as a result of the directed experiences. An educational philosophy then could be defined as "any philosophy dealing with or applied to the process of public or private education and used as a basis for the general determination, interpretation, and evaluation of educational objectives, practices, outcomes, need and materials of study." (A-8, page 295) This can be a part of a philosophy of industrial arts but industrial arts as a division of general education extends beyond these objectives to include many other objectives not reached by general education.

Industrial arts is offered basically for purpose of general education. Through the aid of industrial arts the pupil has the opportunity to explore the various fields of industry and to attain an extensive knowledge about and experiences in some of the work-activities found in industry. A committee appointed by the United States Commission of Education, in its report, Industrial Arts—Its Interpretation in American Schools, defines industrial arts as "a phase of general education that concerns itself with the materials, processes, and products of manufacture, and with the contribution of those engaged in industry. The learning comes through the pupil's experiences with tools and materials and through his study of resultant conditions of life." (A-14)

Wilber defines industrial arts as, "those phases of general education which deals with industry--its organization, materials, occupations, processes, and products and with the problems resulting from the industrial and technological nature of society." (A-26, page 2)

Selvidge and Fryklund, in Principles of Trade and Industrial Teaching, when writing about what the industrial arts program should include, list eight objectives (A-20, page 36) which will be used as a basis for "A Philosophy of Industrial Arts."

1. A Well Developed Interest in Industrial Affairs. With the increased mechanism of our mode of life, it is becoming increasingly desirable if not necessary, that every person has an understanding and a broadened appreciation of industry and its affect on modern life. Young people are very alert to their surroundings and curious as to what goes on about them. The present day homes and communities do not afford a real opportunity for a good understanding of the every-day work life and there is, of necessity, a great need for such an education to bridge this gap.

Interest in mechanical occupation and the conditions and problems of industrial employment are not innate in the individual but the interest must be created. "The typical industrial arts shop probably falls short of giving maximum service to this goal, but industrial arts has within its area of instruction the greatest opportunities afforded by the school curriculum in this important field of education ...." (A-5, page 252) The industrial arts has, then, at its command the possible resources with respect to the tools and equipment needed, to promote such a program where the student can explore and understand our industrial civilization.

2. How to Care For and Use Properly the Things We Buy. Students should be taught conservation of materials and equipment. Perhaps wastefulness in one of the greatest evils in our land today. This can be an outcome of improper training. Care and use of the things we buy "involves knowledge of some of the elementary principles of science such as the affect of heat on metals, affect of moisture on wood, rust, methods of preserving materials, how the electric current works, how to trace the lines of power through mechanism, the principles of machines, lubrication." (A-20, page 40)

These things involve certain fundamental concepts rather than much skill. Over a period of a year, tremendous losses occur from the affect of water alone on materials. Elementary electricity should be taught the student so he can make his own minor repairs such as locating a blown fuse or repairing a bad lamp or iron cord connection.

The student, "should be taught how to care for and preserve materials, how to care for equipment and furnishings in the school and home, and how carefully and thoughtfully to correct, without damage to the article, any difficulty that may appear." (A-20, page 41) The writer feels that this objective is a key objective to this report in that it gives adequate reasons why care of tools and equipment should have a place in an industrial arts program.

Students should be taught to discern between good and bad practices or uses, with what they buy. If a piece does not fit in its place properly, it should not be forced but should be examined to locate the reason for the improper fit. The student should also be taught that pliers or a simililar tool should not be used directly on a polished surface. These are only two examples of the care and use of the things we buy.

3. <u>Appreciation of Good Workmanship and Good Design</u>. This may apply to the workmanship of others as well as that of oneself. Regardless who produced the project the student should be taught to base his judgement upon simplicity, adaptability, proportions, harmony, and quality of the finished product.

Perhaps this could mean also having a good consumers knowledge. Friese says "to foster appreciation of good materials and workmanship for intelligent and discriminating selection of manufactured products for home and business consumption and proper valuation of substantial and beautiful construction in environment." (A-7, page 93) Merely talking about this is not enough but the student should be taught to discern between the fad and the quiet, substantial, or satisfying design; for example the difference between modernistic and modern furniture.

4. <u>Interest in Achievement</u>. Early in life the student should be made to discover his likes and his aptitudes and should be encouraged to learn to do at least a few things well. A person likes to do things he can do well. From the very first, regardless of the smallness of the project, good workmanship should be required. By doing this a pride can be developed within the individual because of the things he can do well. Anything worth doing is worth doing well. Well sharpened and well cared-for tools makes it easier to complete a work job creditably.

Selvidge and Fryklund say, "Pride in one's ability to do things is one of the best guarantees of good citizenship. It can be acquired only through successful accomplishments....." (A-20, page 44) This pride can be developed to the extent of motivation yet one should be humble about it. Praising a boy for some accomplishment if deserving will create interest but praise or approval of a piece of work beyond what it rightly deserves will lead the pupil to lower his ideals and thus decrease respect for himself. Interest in attaining high standards of workmanship may result if high standards are required.

5. Self-discipline and Initiative. In an AVA Bulletin Improving Instruction in Industrial Arts, this statement is found: "This is a responsibility of all teachers but one for which industrial arts teachers possess peculiar readiness. They have unusual opportunity to build self-confidence, judgement, idealism, reliability, obedience to authority or valid custom, ingenuity or self expression." (A-22, page 54) This is possibly one of the greatest aims of the industrial arts program. Little or nothing can be accomplished without self-discipline and initiative. Mays and Casberg, in their book, School Shop Administration, when writing of school shop discipline state, "self-discipline is an aim of education and this is as true of shop teaching as of any other." (A-16, page 147)

This discipline comes from within the individual but can be guided and partially controlled through guidance of others. It is obvious that the necessity for orderly procedure and careful controlled management of the hands, body muscles, tools, materials and machinery necessitates the importance of teaching constant self-management. Students are perhaps the first to notice poor mangement and they in turn lose confidence thus losing self-discipline. Teaching self-discipline then should be considered as a means to an end in shop discipline.

6. Orderly Performance. A completion of a job in an orderly fashion will result in the job being done more completely and much more efficiently. In encountering a job there should first be an analysis to find out what is required, then formulate a plan as to the execution of that job. Thinking or reasoning a job through before attempting to start it is a very wise

decision. Students should be taught this.

In the AVA Bulletin, the objective, Orderly Performance, is "to develop in our pupils the habits of thoughtful, careful work of any kind and the forsaking of loitering and waste......Once established in youth and in school, they will carry to adulthood and to the work of the busy and exacting world." (A-22, page 57) He will then be more dependable in connection with tasks that are assigned him.

7. Drawings and Designs. To the skilled worker in industry, drawing is becoming more and more desirable. "Our industrial arts work affords very effective means for the development of reading knowledge and of the ability and desire of self-expression, both freehand and by use of instruments." (A-22, page 57) Such an objective is meaningful only in industrial arts. Its not enough to discuss only the design but a knowledge of construction and the opportunity to use this knowledge is most essential.

8. Elementary Skills. According to Selvidge and Fryklund these elementary skills should be taught, "in the use of the more common tools and machines, and in the method of modifying and handling materials, in order to make them conform to our needs." (A-20, page 46) This can be helpful in rendering him proficient in the occasional and minor mechanical tasks encountered by the average adult. It can aid him in finding an avocation and by so doing help him to make worthy use of leisure time. Much of the waste found in our home-life today is from a lack of knowledge of how to repair and maintain the mechanisms in our homes. Often safety is overlooked because of ignorance to the dangers that are around us. Not knowing the mechanics of many of these dangers and how to fix them multiplies the danger at hand.

The Place of Care of Wood Working Tools and Equipment in Industrial Arts. Often, to many persons, a tool is just a tool and regardless of its condition, it can be used just as efficiently as when properly cared for. There, perhaps, was never a more eroneous thought. Tools, when dull, can be much more dangerous than when properly sharpened. Also the using of a dull tool results in poor workmanship. Tools left uncared for results in wastefulness. This, indirectly, reflects on character.

Ericson, in his book, Teaching the Industrial Arts, (A-5, page 114) states,

> "(1) This type of work gives training that cannot be had in regular shop work, and is likely to be valuable later: (2) the spirit of cooperation and willingness to step into emergency situations is one of the most valuable assets in life and vocational success: (3) some students are not particularily interested in the regular routine and would rather work on special problems: (4) there are exploratory and guidance values in this work of emergency training---it opens a vision of new fields of vocational opportunities."

The time to start this training is while the student is learning how to use the tools and equipment. He then learns why a plane iron is ground at $22\frac{1}{2}^{0}$ and can also be convinced, while using, that this is perhaps the best angle.

Learning from instruction and a source of knowledge is much better than learning through trial and error. It is less expensive and in most cases, the individual is not equipped for experimentation. The writer, therefore, feels that the care of woodworking tools and equipment has a definite need as an integrate part of the teaching of industrial arts.

Chapter III

HISTORY AND PHILOSOPHY OF TOOLS

Little is known of man in his primitive age because the implements used at that time were made of wood which has deteriorated down through the ages leaving no trace of what they were like. In place of his crude wood knives, man sometimes found a stone and used the ragged edge of it. "When he learned to shape the stone to suit his need, and thus produce a rude tool or weapon, he entered what we now call the Stone Age, more than fifty thousand years ago." (A-1, page 5)

It is hard to tell just what tools were discovered first but perhaps among the earliest hand tools known to man are the saw and file. Ancient man, when abrading or filing an object, used sand, grit, coral, bone, fish skin, gritty wood, and stones of varying hardness to aid him in the process. No one knows definitely when the saw or file was first used and it seems reasonable to believe they were discovered rather than invented.

Ancient Development. Evidence of the use of the file is recorded many years before the time of Christ. Early as the reign of King Saul, about the year 1090 B. C., the file is mentioned. "But all the Isarelites went down to the Philistines, to sharpen every man his share, and his coulter, and his axe, and his mattock. Yet they had a file for the mattocks, and for the coulters, and for the forks, and for the axes, and to sharpen the goads." (I Samuel XIII:20-21) Other hewing tools are also mentioned much earlier than this time but before a sharp edge could be made there must have first been a method of abrading or wearing away the excess to gain this edge.

"Archaeologist estimate that the saw dates back to at least the Neolithic, or Later Stone Age." (A-3, page 88) This suggests that saws were made from flint for metals had not been discovered at that time. These saws varied in length but were used mostly to make ornaments from bones or soft stones. The teeth were made by chipping the edge, leaving a sharp irregular tooth. Although these tools were very crude in form, slow and laborious to use, they doubtless served the primeval man well throughout the stone age. Marked development can be noticed between the early stone age and the later stone ages by the degree of fineness of chipping of the flint.

Striking resemblances are seen in the ancient tool even though they were discovered in different countries. America's earliest records of ancient man were found in Foslom, New Mexico. His tools consisted of flint with ragged edges made by flaking and was very similar to those found in Europe. "The oldest saw of the historical area was found at Ur of the Chaldees in Mesopotamia." (B-18, page 2) Their time dates back to approximately 6,000 or 7,000 years even antedating Abraham by twenty centuries.

Tools other than the file and saw were also made from stone. The flint fist-hatchet, a pear shaped stone of about nine inches long with a cutting edge on either end, was a very versatile tool of those days. It was held in the middle with the fist and could be used in various ways. Some of the more common tools besides the fist-hatchet were the gravers, scrapers of various shapes, tap-borer or a digging tool, and notched tools. Some of the bone tools were the needles, arrow straighteners, and harpoons or fish-hooks.

"Metal reached southeastern Europe not long after 3000 B.C., but in western and northern Europe it was almost 2000 B.C. before the beginning of the Copper Age, which soon became the Bronze Age." (A-1, page 222) It must not be supposed that with the coming of metal, stone tools suddenly were useless for many of the more common tools such as knives were still made from stone. However the introduction of metal meant a rapid advance in civilization.

The invention of the first metal saw was claimed by the Greeks. They boasted of getting the idea from the jawbone of a fish. A more reliable evidence, however, is supplied by the pictures of saws on the Egyptain monuments. These saws were only slightly better than those made from stone. Perhaps it is due to the inefficiency of bronze as saw material. "An almost perfect cast for a bronze saw was found in the ruins of an ancient lake dwelling of Switzerland." (B-18, page 3)

One of the most interesting characteristics of the early Egyptain bronze saw was that the direction of the teeth pointed back. The cutting action, then, was on the pull stroke rather than the conventional saw of today which cuts on the push stroke. The modern Japanese saw still employs the use of the pull stroke. The construction of the early Egyptain saw consisted of a bronze blade with a leather handle. Some saws even appeared to have a tang which was inserted into a handle.

Many prehistoric files were made of bronze and fashioned with rounded backs and a flat surface for rubbing. They had an astonishing likness to the files of today. They were approximately three and five-eights inches in length, three eights inch in width, and one-quarter inch in thickness.

"The Egyptains of the Lisht 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." (A-3, page 119) They appeared to have been made of sheet bronze. Holes were punched through the metal with a sharp pointed instrument and then coiled into a conical shape with the sharp points protruding to the outside. These acted as teeth.

Early Development During Iron Age. With the development of iron an entirely new era was introduced. Previous to this time any material used was very inefficient because of the lack of property to be sharpened and to maintain a sharp edge. Work was slow and much patience and persistence were required to operate the old tools. Now a metal was discovered that had the property of being formed to a desired shape, such as a sharp edge, and could be maintained by abrading or whetting it against a stone.

"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." (A-3, page 120) No doubt the ancient man was quite clever in originating tools. Some ancient Roman files that have been found show evidence of producing the teeth on the file by filing. This was replaced by cutting with a chisel made from a good grade of steel. The later method seemed much faster and more efficient.

Parallel with the introduction of the iron file was the saw made from metal. During the middle ages a Monk, St. Dunstan, produced many wonderful things, and greatly improved those metal tools of that day. Some time later another monk, Theophilus Presbyter, gave the world several formulae for tempering iron instruments. Once the file had been forged to the desired form it was smoothed then the teeth were cut on it. "He describes the hardening process very clearly, and, curiously enough, it does not differ greatly from some present day methods." (A-3, page 122)

In about the year 1490 A. D. the first known attempt to cut files by machine was invented by Leonardo Da Vinci, a noted painter, scientist and engineer. Little recognition was given him, however, and in 1750, Chopitel, a Frenchman, invented a machine which actually cut the files.

"The circular wood saw, as we know it today, was invented in England in 1777 by Samuel Miller, although it has been claimed that circular saws were used in Holland nearly a century before." (B-18, page 4) At the close of the eighteenth century, woodworking was still done by the laborious hand method. The few attempts at inventing machines had proven nearly useless, however, this was the marking of a new area of industrial revolution. "Hand methods were giving way to the newly invented machines in many different fields, notably in the textile industry, and woodworking was soon to undergo the same revolutionary change." (A-9, page 2) In 1799, Samuel Bentham succeeded in inventing several machines where ten unskilled men and one machine could do the work of one hundred and ten skilled men. Because of the success of this experiment, money was given him by the government to further perfect the circular saw.

Current Development. Machines and hand tools are no longer made in a crude manner but has become precision work. Many machines were invented such as the planer, jointer, and the more versatile variety circular saw. Improved methods of making high grade steel makes possible better hand tools. Early American and English furniture was often the product of a very proud and skillful craftsman who prided himself in his fine hand tools. Most of the work was done with hand tools and the early cabinet maker boasted of his choice of steel that went into the making of the tools. Many times these were made by the craftsman himself.

Although basically the same, hand tools have been constantly undergoing changes. Today we have the iron bed hand plane instead of the wooden bed. The files we now have are a precision instrument and are made according to the United States Bureau of Standards.

The file and saw will be used by the writer to show the current development of tools. Both are very good examples of the exactness of their manufacture and both show the development of the high grade steels that are used in tool making of today.

"The making of files which are both high in lasting qualities and correct in design for the various kinds of materials, products, finished and working conditions for which they are intended is an industrial science." (B-23, page 9) To fit the needs of industry today, more than 3000 kinds, sizes and cuts of files have been made to increase efficiency of work on the various kinds of metals used.

The expert manufacture of a file goes far beyond the walls of the factory to the research laboratory. Here the study is concerned with the file steel, file design, file performance, and the metallurgy. A high quality file must first begin with high quality steel. The process of preparing and finishing the file involves forging, annealing, smoothing, cutting hardening, and finishing.

The forging shapes the point, body, and tang of the file. Annealing conditions the steel and to insure uniform grain the large furnaces are expertly controlled and the heat is kept under strict laboratory conditions. The file is then ground to remove scales, then drawfiled to insure even filing surfaces. A machine then cuts the teeth on the file blank. The file is again heated and hardened. After hardening the teeth are sharpened and prepared for service. During all of these operations the file is carefully watched and inspected.

The same care is given the making of the saw. The heat furnished by the furnace is controlled to the closest degree and laboratory supervision is exercised over every process. Though the use of high quality steel is essential in making a fine saw, careful and skilled workmanship is also required.

There are many operations to the making of the high grade saws. These operations are shaping, tempering, taper grinding, tensioning, setting, sharpening, and finishing. The saw is shaped to produce a good balance then tempered to insure cutting points that remain sharp and retain their set. Taper grinding makes the saw blade of proper thickness and gauge along the edge and on back. The saw is tensioned to the sure it will stand up in the cut, then it is set accurately. It is then expertly sharpened and finished so as to give the saw a nice appearance. During these many operations the saw is checked and inspected many times.

Manufacturers are continually striving to perfect better steel and processes so as to make their tools of higher quality. Hand tools are today made with precision machinery and those using them now enjoy the progress and development which started thousands of years ago.

Chapter IV

CARE OF HAND TOOLS OTHER THAN SAWS

Often when observing tools in the work shop or home and farm tool kits, poor conditioning of tools is noticed. In school shops it is very important that these tooks be kept sharp for "it always pays to take the time to sharpen tools, both from the standpoint of performance, as well as actual time saved in the execution of the work." (A-11, page 106) When tools are in poor shape, lack of efficiency results. If good workmanship is expected, tools must be properly sharpened.

This chapter covers the sharpening of the following hand tools: the auger bits, marking gauges, cabinet scraper, hand scraper, lathe tools, pocket knives, plane irons, screw driver, spoke shave, wood chisels, and twist drills.

Sharpening Auger Bits. Rest the bit on a board with the screw pointing up and file lightly on the front edge of each spur. Use an auger bit file. Never file the outside of the spur because this will destroy the clearance of the bit and will definitely impair its cutting action. File the under face of the cutting lip and try to maintain as nearly as possible the original clearance angle. The general angle should remain the same.

Rest the bit on a board with the screw down and file the cutter on the upper edge only. File off the same amount on each cutter. It is essential that both cutters be on the same level so they will cut chips of equal thickness.

References: A-2-34, A-4-142, B-22-6, B-28-2.

Sharpening the Cabinet Scraper. The cabinet scraper is a faster cutting tool than the hand scraper and therefore is sharpened at a more acute angle. First file the scraper with an angle of approximately 60° to 75°.

Then place the scraper in a vise and burnish the edge over by drawing burnisher at about 15° and finally at about an angle of 8°. This puts a hook on the edge which cuts, or shears off the fiber ends thus giving a very smooth cut.

References: B-18-53, B-33-57

Sharpening Hand Scrapers. Clamp the scraper to be sharpened in a vise and remove old edge by holding the file flat against the side and filing. File the edge at 90° by holding file so that line of teeth are perpendicular to face of scraper, then draw file until the edge is square. With a burnisher or a well tempered chisel, turn edges. Hold burnisher horizontal and draw straight across the entire length of the edge. Repeat this operation two or three times then hold the burnisher about 5° to horizontal and again repeat the operations. A very high grade of sharpening can be done by first whetting the scraper edge before using the burnisher.

Reference: A-11-112, B-33-57

Sharpening Marking Gauges. The spur may be removed from the beam of the marking gauge by loosening a screw. Sharpen the spur in much the same manner as a pocket knife would be sharpened.

Sharpening Lathe Tools. The gouge is perhaps the most difficult lathe tool to sharpen. The angle on the back side to the cutting edge should be 30°. Hold the tool horizontally so that the back edge to be ground is parallel with the cutting edge of the stone. Revolve the tool slowly being careful to maintain a proper angle while it is rotated. The round nose is ground in exactly the same manner as the gouge.

The parting tool is hollow ground and has an included angle of 40°. The cutting edge is ground at 90° with the body of the tool.

The skew is somewhat different from other lathe tools in that it has a bevel on both sides and the cutting edge is not at right angles to the sides. It is hollow ground and ground with an included angle of 24° or 12° from center line. The cutting edge is ground 15° to 20° less than 90° or 70° to 75° with the side. Care should be taken to keep the cutting edge horizontal with the face of the stone so as to maintain an even bevel back from the cutting edge.

All lathe tools should be whetted to remove burrs and to insure a smooth sharp edge. The slip stone is used on the inside surfaces, while the outside surfaces may be whetted on a standard oilstone.

References: A-11-116, A-15-14, C-1

Sharpening Pocket Knives. To make possible a keen edge on a knife, it must be ground so that the blade is very thin at the edge. Hold the side of the knife blade against the side of the grinding wheel and grind from the edge to the back of the blade. This will insure a long bevel and will reduce whetting considerably. The edge will not become blunt nearly so soon. Lay the blade flat on the whet stone and whet alternately one side then the other until no bright spots can be seen on the edge. An added keeness can be given to the edge if the blade is stropped.

Reference: A-2-37

Sharpening Plane Irons. Plane irons are hollow ground to an angle of approximately 22½°, with the cutting edge at 90° to the side. The bevel is uniform and straight across except that the corners are slightly rounded. Whet the plane iron by placing it first beside the plane and lower it slightly. This angle will be approximately 35° to 40°. Whet the beveled edge, then whet a few times on other side holding the iron flat on the stone. Whet last time on bevel side.

References: A-2-13, A-4-44, A-6-188, A-12-83, C-2

Sharpening Screw Drivers. Hollow grind the blade of the screw driver on both sides to the thickness of the slot of the screw to be driven. The width of the screw driver should be approximately the same as the diameter of the head of the screw. Grind the face of the blade a distance of about $\frac{1}{4}$". This will give a sufficiently hollow ground fit to insure the sides to be parallel at the point of the blade. If the blade has been chipped or damaged and a new blade must be formed, then the sides should have a radius of approximately the same as a circle whose diameter is the same as the width of the blade. When grinding a screw driver it is always well to have a screw of a size the screw driver is to be ground.

Reference: A-2-44, A-4-66, A-6-192, A-17-40

Sharpening Spoke Shaves. The spokeshave is ground in a very similar manner to the plane iron. It is ground to a bevel of about 25° and whetted just like a plane iron.

Sharpening Wood Chisels. Grind the wood chisel straight across and to a bevel of about $22\frac{1}{2}$°. Care should be taken when grinding so as to not burn the metal. This will destroy the temper and render the chisel soft thus causing it to lose edge very easy. Whet at the same bevel as the chisel is ground. Whet first on the bevel side then on the face side.

References: A-2-44, A-6-56, C-2

Sharpening The Twist Drills. A drill has two cutting lips that are ground to the same length and at an angle of 59° to the center line or 118° included angle. Hold the drill in both hands at 59° to the face of the stone. Place the cutting lips to the face of the grinding wheel. With the drill in the same relative position raise it up and forward keeping it against the face of the stone. This makes the heel lower than the cutting lips. The angle this makes with the point of the drill is called the lip clearance angle and should be from 8° to 12°.

References: A-19-22, B-5-9.

A list of tools and equipment needed for the operations mentioned for conditioning hand tools is given here: for the auger bits, one or more auger bit files; for the cabinet and hand scraper, a burnisher, a flat mile file, an oil stone, and a vise; for the marking gauge, a file and an oil stone; for the lathe tools, pocket knives, plane irons, spoke shaves, a wood chisel, a grinding wheel, an oil stone, and possibly a strop; for the screw driver and twist drill, a grinding wheel.

Chapter V

EMERY WHEEL GRINDERS AND OIL STONES

Perhaps a grinding stone could be thought of as a milling wheel with thousands of small cutters on it and at each revolution of the wheel, tiny particles of metal are removed. Because of these thousands of cutters revolving at a high peripheral speed, care must be taken when selecting the right wheel for the job to be done so that the proper consideration will be given to the bonding, rim speed, and abrasive.

Grinding wheels can be used in the shop when finishing materials to very close limits or they can be used for the removal of excess metal where limits are meaningless. In this chapter, only those grinding wheels used for sharpening of woodworking tools, will be considered. The type of grinding wheel needed for sharpening woodworking tools is one that will be easily trued and will give a smooth surface to the tool being ground.

<u>Truing Up Emery Wheels</u>. To true up or dress an emery wheel means to remove a small layer from the face of the wheel thus making the outside edge of the wheel concentric with the axis or center of the wheel. When grinding wheels become clogged with oil, dirt, particles of steel, glazed, sometimes worn out of round, then truing is necessary in order to make the wheels efficient for grinding again.

There are two common methods of truing an emery wheel. One is by using the star emery wheel dresser and the other is to use a diamond point dresser. Unless precision work is to be done and for all practical purposes, the star emery wheel dresser is satisfactory.

The star wheel dresser consists of a cluster of star wheels mounted on a shaft and separated by thin steel discs. These are mounted in the end of an iron holder. To true the stone first rest the heel of the iron holder on the tool rest and as these star wheels are brought in contact with the grinding wheel, they revolve at high speed and in doing so remove or cut away the surface of the stone thus truing it. After considerable use, the star wheel becomes worn and must be replaced.

In truing with the diamond, rest the holder against the tool rest and move the dresser from one side to the other. The diamond point is much harder than the grinding wheel and as it comes in contact with the wheel it removes a layer of the surface. For precision turing the diamond point is mounted in a holder that will move to one side and the other always parallel to the face of the grinding wheel. This gives a perfectly even cutting face on the grinding wheel.

Reference: A-4-355, A-5-135, A-10-10, B-24, B-25

Selecting Emery Wheels. Before replacing an emery wheel, first consider the type of work to be done and the motor speed. From these two facts can be determined the abrasive and the type of bonding needed.

The abrasive does the actual cutting and can be purchased in several different grain or grit sizes indicated by the number of openings per linear inch in the screen used to size the grain.

The bonding is the cementing or holding together of the abrasive. Perhaps seventy-five per cent of the grinding wheels use a vitrified bonding. For special jobs other types of bonding are used. This bonding is graded indicating the relative strength or holding power of the bonding. In general, the stronger the bonding material the harder the grade.

Perhaps a good rule in selecting a stone is the higher the wheel speeds, with relation to work speed, the softer the wheel should be. Vitrified bonding can be used for speeds up to 6500 s.f.p.m.

References: B-24, B-25

Replacing Emery Wheels. A good safety precaution in replacing a grinding wheel is to always be sure the motor does not turn the grinding wheel in excess of the speed marked on the wheel. If the wheel is large never roll it along the floor because the edges might chip. Before placing in the mandrel tap the wheel gently to see if it has a clear ring which indicates sound structure. Both flanges should always have the same diameter and be at least one-third the diameter of the grinding wheel. There should also be a blotting paper washer on each side of the wheel. After mounting, tighten the spindle end nut firmly but now excessively.

All good wheels have been tested to a maximum speed and will be marked as such. When first starting the motor after mojnting, stand clear and turn on the motor switch and allow to run for a short time. If there were any possible hidden flaws this will give the wheel a trial run.

Reference: B-26

Care of Oil Stones. The oil stone should be kept moist at all times. to allow it to dry will cause it to harden. After using each time the dirty oil should be wiped off and when not in use a few drops of clean oil should be left on it. The oil stone should also be protected by keeping in a box while not in use. Use an oilstone oil made of half lubrication oil and half kerosene.

When using the oil stone the entire face should be used to prevent uneven wearing and hollowing out the middle. A separate stone should be used when sharpening such tools as the gouge or round-nose tools.

If the stone becomes glazed or gummed up, they can be cleaned with ammonia. If not then a piece of abrasive paper or cloth may be used. When the stone becomes worn or hollow in the center, it can be sharpened or refaced by grinding on a iron plate. This is done by first placing grinding compound on the true face of the cast iron base then rub the stone over it in a circular or forward and backward movement. This will wear the oil stone until the face is true again.

Reference: B-24-25, C-3

The grinding wheel and the oil stone are absolutely necessary is all shops where sharpening of tools are done. For this reason it is very important that good care be taken in choosing the right stone for the job to be done and that it be kept in proper condition for maximum efficiency when conditioning the tools. The India oilstone made by the Norton Company is recommended for the school shop. Buy two stones 1" x 2" x 8" in size, one medium grade and one fine.

Chapter VI

HAND SAWS

Before starting to work on reconditioning the hand saw an examination of the condition of the saw is required. Inspect the saw to see if the teeth are uniform in size and shape, and if the teeth need to be set. A saw cannot give good service unless the teeth are even, uniform in size, and properly shaped.

The various kinds of hand saws found in the industrial arts shop are cross-cut hand saw, rip hand saw, back saw, miter saw, dovetail saw, compass saw, keyhole saw, pattern maker's saw, and coping saw. There are perhaps only two types of teeth, the cross-cut teeth and rip teeth found on the hand saws. Since all saws have basically one of these two types of teeth, there is no need for an explanation of procedure for them. This report is concerned primarily with the following saws: Hand rip saw, hand cross-cut saw, back saws, and the 2-man cross-cut saw.

Jointing Hand Saws. Filing the points of the teeth on a hand saw to make the line of teeth straight or in a gentle curve is called jointing. This process may be completed with a "Disston Hand Saw Jointer" or by hand without the aid of a bought jointing device. In any event the results are the same if carefully done. The procedure is to clamp the saw in the vise and run a flat file across the point's of the teeth until all or nearly all have "flats" on them. The flats are essential for filing the teeth even. Jointing is not necessary everytime the saw is filed.

References: A-4-38, A-12-205, A-19-57, B-18-15, B-19-17, B-23-41

Kinds and Sizes of Files. When choosing a file for hand saw filing, it is necessary that the file be of sufficient width to insure filing the complete tooth. A good rule to follow is to select a file whose width is one-fourth wider than the length of the longest side of the tooth to be filed. All hand saws are filed with triangular tapered files. Well designed handles are necessary for all files. Order these or make a supply of them in the school shop.

References: B-2-20, B-4-84, 85, B-6, B-7, B-19-2, B-23, B-31, C-13.

Setting Hand Saws. Springing over the upper part of the tooth is called setting. The teeth are set alternately to the right and left. This makes the teeth cut a slightly wider kerf than the saw allowing the saw to move freely through the kerf. Set the saw teeth approximately one-third to one-half way down on the tooth. More set than this will result in distortion to the body of the saw. Use a "pistol grip" saw set to provide easiest hand work.

When setting a back saw a Millers Fall hand set may be used by first grinding down the hammer and anvil to the proper width.

References: A-4-38, A-12-206, A-19-61, B-3-19, B-18-17, B-19-3, B-23-42.

Filing Hand Rip Saws. Place the saw in the vise with handle to the left and file toward handle. The front of the teeth should be filed so there will be a 0° to 2° negative rake. The file point should point toward the handle of the saw so that the front edge of the tooth forms an acute angle of about 88°. The handle should be approximately 5° below horizontal. File only one-half of flats on the teeth to right and left of file when filing first side. Reverse the saw in the vise and file until the remaining flats to the right and left disappear at the same time. The teeth should all be the same size and height.

References: A-2-24, A-4-39, A-12-205, A-19-58, B-3-22, B-18-20, B-19-3, B-23-43, C-4.

Filing Hand Cross-cut Saws. Clamp the saw in the vise with handle to the left as when filing the rip saw. File from the point of the saw to the handle on the right side of the tooth leaning toward the operator. Hold the file with its point toward the handle making a 60° angle with the far side of the saw. The front of the tooth should have a negative rake of 10°. Hold the handle of the file approximately 10° below horizontal. File one-half of flats to the right and left of the file. Reverse and file remaining half of flats. If properly filed a needle will slide between the outer points of the teeth.

References: A-2-26, A-4-40, A-12-208, A-17-225, A-19-62, B-3-22, B-18-20, B-19-4, B-23-42, C-4.

Filing Back Saws. Follow the same instructions as for filing the cross-cut saw. Back saws usually have fourteen points to the inch and the smallest triangular tapered file made should be used. This will be a four inch, double extra slim taper file. Set saw teeth with finest saw set available. The plunger on this saw set may need to be ground narrower.

Filing the 2-man Cross-cut Saw. After jointing, the raker teeth must be filed so there will be approximately one-thirty second inch to one-sixty fourth inch clearance below the line of teeth depending on the kind of wood to be sawed. Every other tooth is filed from one side then the saw is reversed and filed from reverse side. The following files are used for filing this saw: Mill file with one round edge, cant saw file, and cross-cut file.

References: A-19-71, B-2-43

Tools Required For Filing Hand Saws. When jointing a saw a flat mill file is used. A bought saw jointing device may be used. The saw vise can be a bought vise or one can be made from two pieces of board with a bolt through them so they can be forced together thus holding the saw in place. For setting a hand saw a pistol grip hand saw set is used. A special saw set can be made for setting the back saw or very fine tooth cross-cut saw by grinding the hammer and anvil of a "Millers Falls" hand saw set narrow enough so the procedure of setting will not interfer with the teeth next to the one being set. When filing the hand saw various sizes of triangular tapered files are used depending on the number of points per inch the saw has.

Chapter VII

THE BAND SAW

Narrow band saws are used extensively in woodworking establishments. The blades are made as narrow as one-fourth inch and are graduated by eighths to the three-fourths inch saw. Wider saws may be obtained. The commonly used widths are one-fourth, three-eighths, one-half, and three-fourths inch. The length varies according to the size and kind of band sawing machine used.

There are perhaps three causes of band saw failure: (1) the band saw blade may have too little set in the teeth thus the kerf cut by the saw will not be of sufficient width for the blade and the result is over heating, (2) the band saw may become dull from normal use. When a blade becomes dull it rubs rather than cuts and will cause excessive friction which in turn causes over heating. (3) The normal bending of a band saw blade forming around the wheel then straightening out again as it cuts the wood, will to some extent, cause the blade to crystallize in time. As a result, the blade breaks. An indication of crystallization can probably be noticed by the checks that may appear in the gullets between the teeth.

Jointing Band Saws. Jointing the band saw may be accomplished by reversing the band saw blade so that the teeth point up instead of down. Start the saw and using a broken piece of emery wheel, touch the edge of the teeth lightly until a flat can be seen on most of the teeth. The purpose for jointing is to make the cutting line of the teeth even.

Reference: A-13-113.

Hand Filing Band Saws. Place the band saw blade in a vise made for that purpose. File straight across the blade holding the file at 90° horizontally to the blade. This keeps the front of the tooth square. Hold the file so that it will make also an angle of 6° to 8° with the vertical. This will give the tooth a positive rake of 6° to 8°. File all teeth from the same side of blade.

References: A-9-346, B-1-5, B-2-24, B-16-1, C-9

Setting Band Saws. Band saws may be set by hand using a hand saw set of a size appropriate to the guage of the saw or by using a band saw setting machine. When setting by either method the results should be the same. The set should not extend more than one-third to one-half the way down on the tooth. More set that this will tend to distort the body of the blade. Set the teeth alternately right and left.

References: B-1-6, B-2-24, B-30-12

Machine Filing Band Saws. Filing a band saw blade by machine can be accomplished much faster and with more uniformity than by the hand method. Care should be taken when selecting a file. It should be of such width as to file the full length of the tooth. A good rule to follow is to choose a file whose width is one-fourth wider than the length of the longest side of the tooth to be filed. Care should be taken when adjusting the file in the machine so that a positive rake of 6° to 8° will be filed on the tooth.

References: A-9-346, B-1-5, B-16-3, B-30-13

Brazing Band Saws. The set in the blade will alternate right and left therefore care should be taken to match the teeth when lapping. Let the lap be approximately one and one-fourth times the width of the blade. Taper the ends back the width of the lap with a file. Place saw in brazing machine with teeth pointing toward the operator. Be sure the back side of the blade is against the rail so that the blade will be straight when brazed. Insert a small piece of silver solder between the lap surfaces and flux the surfaces. Use borax and a liquid flux so that a good electrical contact will be obtained. Engage the switch and allow the blade to become a light red. Turn off the switch and pull the clamp lever down on the joint immediately. This will force the joint together causing it to become brazed. Allow to cool for a short time then loosen one clamp slightly and engage the switch again heating the blade to a dull red. Allow the blade to cool slowly. This process is called annealing.

References: A-9-343, A-13-114, B-1-7, B-2-24, B-16-5, C-11

Butt Welding Band Saws. An electric butt-welding machine is required to do this operation. Very little time is required and the results are very satisfactory. The ends of the blade are cut so the teeth match. Approximately one-sixteenth inch of the blade is needed to make the weld. The band saw blade is placed in the machine with the two ends butted together. The voltage and amperage are then adjusted for the size of blade to be welded. As the switch is engaged an arc is created between the butts of the blade thus causing them to become very hot. Automatically pressure is applied by the machine forcing the two ends together thus completing the weld. Annealing is required for this joint.

Suggestions. When buying band saw blades it is wise to secure several. The cost over a period of ti e will be no more and this will facilitate conditioning the band saw blades by allowing some of them to be sent in to the factory or to a near-by repair shop for brazing and sharpening and there will still be some left for use.

Whether filing the blade by hand or with machine, the triangular tapered file of suitable size is used. A hand made vise can be made in much the same manner as for the hand saw except it will be longer. The following special tools are needed for complete care of band saws in a school shop: A triangular tapered file of suitable size, an "Oliver Saw

Brazer," a band saw setting machine, and a band saw filing machine.

Chapter VIII

THE CIRCULAR SAW

Uneveness of saw teeth is the result of normal wear, cutting nails, dropping the saw blade, and extreme carelessness. To get the most efficiency from saws the tool should not only be kept sharp but each tooth should be of equal height. When a saw has long and short teeth it follows that the long teeth will have the most work to do. This causes the long tooth to dull quickly. The unequal strain of the increased cutting action on the longer tooth will cause the saw to deviate from its cutting line and will give bad results generally. Lack of the proper set will result in increased friction and will cause burning.

In this chapter the procedures for laying out the circular cross-cut and the circular rip saw are explained. Other procedures such as jointing, setting, gumming, and filing are also explained. Results from these procedures have been tried and have proven very satisfactory.

Jointing Circular Saws. To make it possible to even up all teeth in the filing processs, the teeth must first be filed or ground to the same length. This process is called jointing. Any circular saw should be jointed about ever third or fourth filing. It is perhaps more important on circular saws than hand saws. The peripheral speeds the circular saw are subjected to cause excessive heat and vibration if the teeth are uneven thus causing an unbalanced saw..

To joint a saw, remove the saw from the arbor and place on in a reversed position so that the teeth are pointing away from the operator or opposite to the direction of rotation. Lower the blade until it is below the surface of the table. Start the motor and move a piece of broken emery wheel directly above the blade. Raise the blade until it just strikes the emery stone then move the stone back and forth over the blade. Stop machine and check the flats. Repeat this operation until all or almost all of the teeth have been touched by the stone.

References: A-13-168

Laying Out and Gumming Circular Rip Saws. After several filings the gullets between the teeth become very shallow and will clog easily and not carry away the sawdust adequately. They must therefore be ground to their original depth. This is called gumming.

Lay out the saw in ten equally spaced circles using the outside circumference as the tenth circle. From the front of the tooth, draw a line tangent to circle number five. From the point of the tooth to be laid out draw a line back to the top or point of the fourth or fifth tooth back. Measure on the line from the point of the tooth to be laid out, back a distance equal to approximately one-twentieth of the outside diameter of the saw. From this point construct a tangent to circle number eight.

References: A-9-338, A-13-173, C-7

Gumming. In gumming, a grinder can be used or else a woodturning lathe. The stone should be about one-half inch thick and about seven inches in diameter. Form to correct shape with a diamond point dresser. Hold the saw on the tool rest and grind out the gullets to a depth of circle nine and at the same time shape the front or rake of the tooth to the lay-out line. Do not grind too fast as this will burn the saw. The stone should run at a surface speed of about "a mile a minute." This will be approximately 2500 r.p.m.

References: A-13-172, A-9-263, C-10.

Setting Circular Saws. Bending the point of the tooth to give clearance for the saw blade in the kerf is called setting. This will vary with the kind of wood to be sawed but in general is from 3/16" to 5/16" of the tip end of each tooth.

Heavy gauge circular saws may be set by employing the use of a flat cast iron base and a broken three cornered file. Select an old three cornered file, break it and grind the broken end flat. File a corner on the cast iron base to such an angle so that it willcause the proper amount of set in the saw. A purchased circular saw set called a "saw stake", may also be used for this job.

Lay the saw blade flat on the base and locate the center of the saw and one edge of the saw tooth. Using the home manufactured punch and a hammer, strike the tooth a good heavy blow thus causing the tooth to bend to the degree filed on the iron base. Using the same locating points relocate the saw, skipping a tooth, in the same relative position and repeat the operation. An anvil could be used in place of the iron base.

Thin circular saws may be set by using a heavy duty pistol-grip hand saw set. Those gauges that can be set by this method are gauge number thirteen through gauge number fifteen.

References: A-9-339, A-13-169

Filing Circular Rip Saws. Place the saw in a saw vise. File the front of the tooth to the line described in lay-out procedure for gumming. Hold the file, when filing the front of the tooth, so that it makes an angle of 88° with the face of the saw. File the tip of the tooth straight across to the layout line until the flat disappears. Hold the file so the handle is 2° to 5° below horizontal. File every other tooth from one side and reverse the saw and file the remaining teeth. A flat round edge mill file is used for this filing operation.

References: A-9-342, A-13-170, C-7

Swaging Circular Rip Saws. Spreading the point of the tooth is called swaging. The saw must first be jointed and gummed and then the teeth filed to a sharp edge and shaped to fit the gauge provided with the swage. Extreme care should be taken to be sure this fitting is properly done.

First apply oil to the tooth and use the convex die to spread the tooth. Next use the straight die to make a finished edge on the tooth. The tongue in the center of the swage should always be in the center of the tooth. Use a light hammer and do not strike heavy blows. Hold the swage in a position so that the tooth will spread without driving the edge of the tooth below the cutting line. After all the teeth have been swaged, they must be filed. File straight across leaving all points the same width.

References: A-9-340, B-12, B-27, B-16, C-12

Filing Circular Cross-cut Saws. Lay off circle number two in the same manners as the circular rip saw. Draw the line from the front side of the tooth tangent to circle number two to the right side of the center. Place the file on the right side of the tooth leaning toward the operator and hold it in such a position so as to make a 60° angle with the far side of the saw blade. Hold the handle of the file away from the operator and approximately 15° down from horizontal. File every other tooth then reverse the saw in the vise and file the remaining teeth.

An excellent file guide may be made for use when filing the circular cross-cut saw and the hand cross-cut saw. A piece of stove pipe tin is purchased and cut to a size best suited for the saw vise used. With a scribe and with the aid of a protractor, guide lines may be marked the desired angle on the tin. Bend the tin at 90° and place between vise and back side of blade. This tin can then be bent up to the angle for the horizontal position of the file and can be used as a guide. The guide lines can be used to aline the file to the correct angle to file.

References: A-9-342, A-10-129, A-B-177, B-1-9, B-10, C-5

Filing Circular Combination Saws. The cross-cut teeth on the combination saw are laid out in the same manner as on the circular cross-cut saw, with the exception of the back side of the cross-cut tooth next to the tip tooth. Draw the back side of this tooth tangent to circle number six. The lay out method for the rip tooth is the same as for the circular rip saw with the exception of the back side of the rip tooth which is drawn tangent to circle number eight and one-half. File the rip teeth straight across all from the same side, These teeth must be 1/32" shorter than the cross-cut teeth. File the cross-cut teeth in same manner as those on a circular cross-cut saw.

References: B-8, C-6

Filing Dado Saws. When filing the dado saw a special filing clamp as shown in Appendix c- is used. A square saw file is used and is held parallel with the floor. The operator lines the file parallel with the guides lines of 82° that are marked on the filing clamp base. The clamp is tilted at an angle of 38°thus making the teeth filed at an angle of 52°from horizontal.

The cleaner teeth must always be filed from one sixty-fourth inch to one thirty-second inch lower than the cutting teeth. Failure to observe this rule will bring the cleaner teeth into the cutting and result in unsatisfactory service. The saw must be gummed occasionally to keep cleaner teeth lose and positive.

Reference: B-15-8, C-8.

Equipment Used For Fitting Circular Saws. A good circular saw clamp or vise can be made by using two flat pieces of boards. A very good example is given in Hjorth, Machine Woodworking, (A-9, page 343) A special tool is required when swaging a rip saw. The set consists of a swage with a convex die and straight die and a tooth gauge. The kind of file to use when filing a circular rip saw is a flat round edge mill file. A triangular tapered file of the proper size is used for filing the crosscut saw. When jointing the saw, any broken emery wheel will do for the job, just so it is of sufficient size so as to reach across the throat of the saw table. When gumming a soft stone is perhaps the best and should be about seven inches in diameter.

Chapter IX

CONCLUSION AND RECOMMENDATIONS

Long before man knew anything about machinery, he discovered and invented hand tools. If it were not for the fact that a way to sharpen these tools was discovered,progress would have been much slower than it was. Thus, care of woodworking tools and equipment is a very important part in teaching industrial arts. Without the aid of a sharp tool the delicacy or detail that is seen in so many woodworking projects would not be possible.

The writer, when working in a woodworking shop, has on various occasions started to use a tool without having realized the extent of its poor condition. For instance when using a dull circular combination saw for exact work, the saw was found to crowd the work piece and not make a square cut. With the type of tools and equipment of today it is possible that the work may be quite exacting. Dull tools prohibit this exacting workmanship.

When conditioning tools, great importance should also be given to the types and kinds of equipment used to care for these tools. Many good examples of this can be seen in many woodworking shops. Such practices as using a square edge flat mill file for filing gullets or the front side of the teeth on a circular saw should never be allowed.

These procedures described in this report have been tried and proven to be good. Although there may be several methods of how to care for the same tool yet there is no place in the shop for careless workmanship. When hollow grinding a chisel, there may be more than one angle to grind it, depending on the kind of wood its to be used on, yet the same rule for squareness and hollow grinding would apply for every angle. Secondary bevels are not permissable.

Along with this care of tools and equipment comes, perhaps the greatest objective of all, character building. The student, himself, should be a product of the project rather than the project a product of the student. In building a project, the student can show initiative, good design, stableness of character, and many other traits of personality which should be the aim of all industrial arts education. Through teaching care of tools and equipment, self-confidence can be built up within the student because working with sharp tools is always easier than with dull tools and the extent to which he can apply himself is more encouraging.

Recommendations. The writer recommends that "Care of Woodworking Tools and Equipment" be an integral part of the total industrial arts program and be taught in a more organized fashion, along with teaching the use and operations of woodworking tools and equipment. He suggests that as a result of this recommendation, the student will become more proficient in his work because of the efficiency obtained from the tool and worker when the tools are sharp. This will aid in building better cooperation, more self-discipline, and will increase his skill thus resulting in a total building of character.

Appendix A

A SELECTED BIBLIOGRAPHY

Books Containing Information About Care of Wood Working Tools and Equipment.

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27. Willoughby, George Alonzo, and Chamberlain, Duane G., General Shop Handbook, The Manual Arts Press, 1943.

Appendix B

A List of Free Publications Containing Information About Care of Shop Equipment.

1. Atkins, E. C., Fitting Narrow Band and Small Circular Saws.
2. Atkins, E. C., Saws in The Filing Room.
3. Atkins, E. C., Saw Sense.
4. Broadhead Garrett Company, Catalog.
5. Cleveland Twist Drill Company, Handbook for Drillers.
6. Delta File Works, Delta Files Catalog No. 47.
7. Delta File Works, Files, How to Select, Use and Conserve Them.
8. Disston, Henry, Circular Combination Saw (solid tooth).
9. Disston, Henry, Circular Combination Saw (hollow ground).
10. Disston, Henry, Circular Cross-cut Saws.
11. Disston, Henry, "Rights" and "Wrongs".
12. Disston, Henry, Circular Cut-off Saw (solid tooth).
13. Disston, Henry, Circular Rip Saw (spring-set).
14. Disston, Henry, Circular Rip Saw (swage-set).
15. Disston, Henry, Dado Saw.
16. Disston, Henry, Band Saw (narrow wood).
17. Disston, Henry, Machine Knives.
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22. Irwin, How to Select, Use, and Care for Bits.

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27. Norton, The Grinding Wheel, Its Care and Use.

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30. Simonds, Care and Use of Narrow Band Saws.

31. Simonds, File Facts.

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33. Stanley, Tool Catalog.

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Appendix C

Plate	Mimeographed and Printed References
1.	How To Sharpen Lathe Tools
2.	How to Care for a Plane and Sharpen a Plane Iron
3.	Selection, Installation and Care of Oilstones
4.	Method of Filing Hand Saws
5.	Layout and Method of Filing Circular Cross-cut Saws
6.	Layout and Method of Filing Combination Saws
7.	Layout and Method of Filing Circular Rip Saws
8.	Dado Head Filing Clamp
9.	Method of Filing Band Saws
10.	A Saw Gumming Device for Use on a Wood Turning Lathe
11.	Directions for Using the "Oliver" Band Saw Brazer
12.	Directions for Using Disston Conqueror Swage
13.	File Sizes for Hand Saws

HOW TO SHARPEN LATHE TOOLS

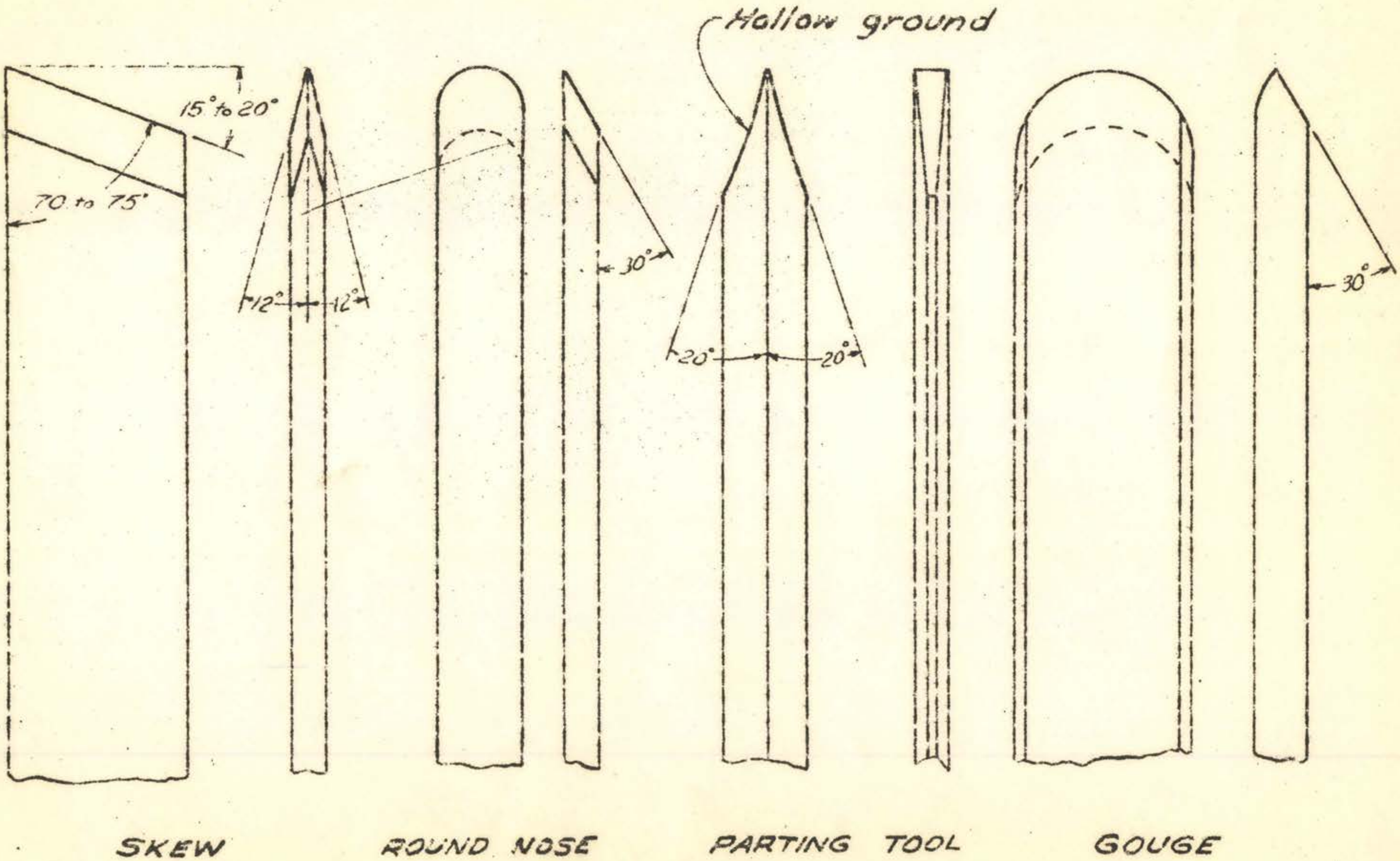


Plate 1

How to Care for a Plane and Sharpen a Plane Iron - - - - - - - - - - - - - by DeWitt Hunt

Purposes: This instruction sheet is designed to give enough information to the home repair man to enable him to recondition a plane. The plane is an indispensable tool for use in general repair work especially in repairing furniture, parts of the dwelling or other frame structures about the homestead.

Materials and Tools Needed: Jack plane or smooth plane good quality oilstone such as Carborundum or India brands and oilstone oil composed of equal parts lubricating oil and kerosene.

Chief References: Hunt, Hand Woodworking, Chap. 4; Douglas and Roberts, Instructional and Informational Units in Hand Woodworking, pages 38-39.

Procedure: The plane itself may need some reconditioning. Broken parts may be welded or replaced with new parts. Handle screws may need tightening. The frog may need to be adjusted so that the throat opening is larger or smaller. Rough corners around the edges of the plane bed may be filed smooth. Rust spots may be removed by using sandpaper or emery cloth. An application of oilstone oil will assist in removing the rust. For sharpening follow the procedure given in the following steps.

1. Remove the plane iron assembly from the plane.

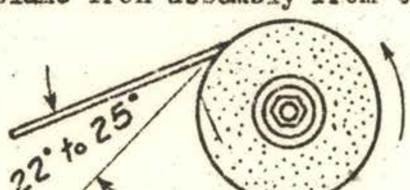


Figure 1. Grinding the Cutting Iron

2. Loosen the cap screw but do not remove it. It is customary to use the lever cap as a screw driver in loosening this screw. Separate the cutting iron and place iron cap, leaving the cap screw in place so it will not be lost.

3. Grind the cutting iron using either a water grindstone, an oilstone grinder or an emery stone. See Fig. 1. The bevel at which the cutting iron should be ground is 22° to 25°. The cutting iron rests on the frog and makes an angle of 45° with the base of the plane. The angle of grinding is approximately one-half of this angle. The corners may be ground slightly rounding. See Fig. 2.

4. It may be necessary for the home owner to have some one else grind the cutting iron. Students in the local high school industrial arts classes should be able to do this.

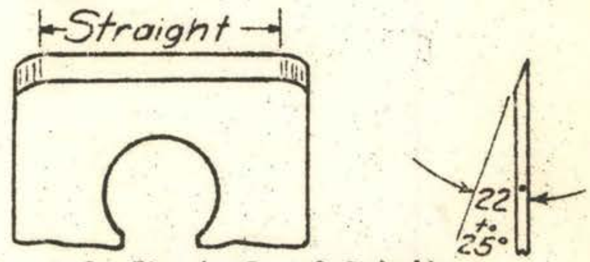


Figure 2. The Angle of Grinding

5. The whetting should be done by holding the cutting iron at an angle of 35° to 40° to the face of the stone. The bevel should be down. See Fig. 3.

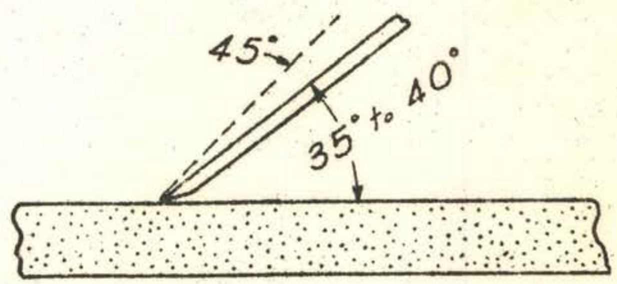


Figure 3. Angle of Whetting

6. Frequently the cutting iron must be whetted on opposite side. Hold it flat on oilstone or raise and opposite bevel about 2° to 4° above face of stone.

7. Whet alternately on bevel side and face side of cutting iron until all wire edges are removed and until the cutting edge should be sharp.

8. The cutting edge should be sharp to the touch and no wire edge should be recognizable on either face or on cutting edge. A well sharpened plane iron will shave.

9. Note that a small secondary bevel of 35° is whetted on the point of the plane. See Fig. 3.

Plate 2

A SERIES OF INSTRUCTION SHEETS
Planned and Produced by Graduate Students in the
Department of Industrial Arts Education and Engineering Shopwork
Oklahoma A. and M. College

Selection, Installation and Care of Oilstones — Summer, 1945, Cliff Tinkle

Purpose: To learn how to select, to install and to care for the oilstones in a school shop. Selection: The one best for a high school shop. Installation: Where should it be located? Care: What kind of oil to use and how to true up when the oilstone becomes uneven.

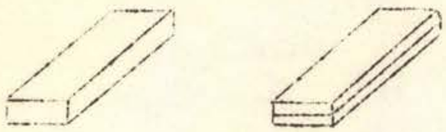


Fig. 1. A Fine and a Combination Oilstone

Materials and Tools Needed: An oilstone, a piece of cast iron with one true surface, coarse valve grinding compound, a good grade of oil, rags, and some kerosene.

References: How to Sharpen, Behr Manning Co., Troy, N. Y.; Short Cuts to Better Work for the Home Craftsman, Carborundum Co., Niagara Falls, N. Y.

Selection: Two oilstones should be provided in the usual shop. One should be a fine stone which is good for finishing. The other should be a combination of two grits, a coarse and a fine. The coarse side will restore dull edges and the fine side will produce a finished edge. The best size for a school shop is the 8 x 2 x 1 inch.

Several companies manufacture these stones. The Behr Manning Company manufactures the India, Crystolon, and the Hard Arkansas. The Carborundum Company manufactures several. Each costs about $1.75.

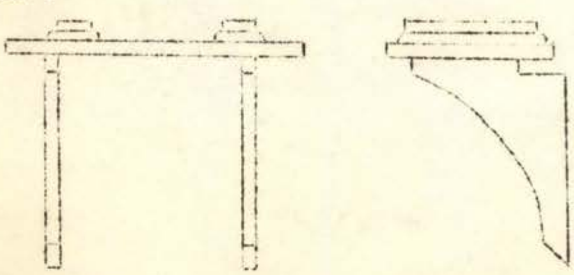


Fig. 2

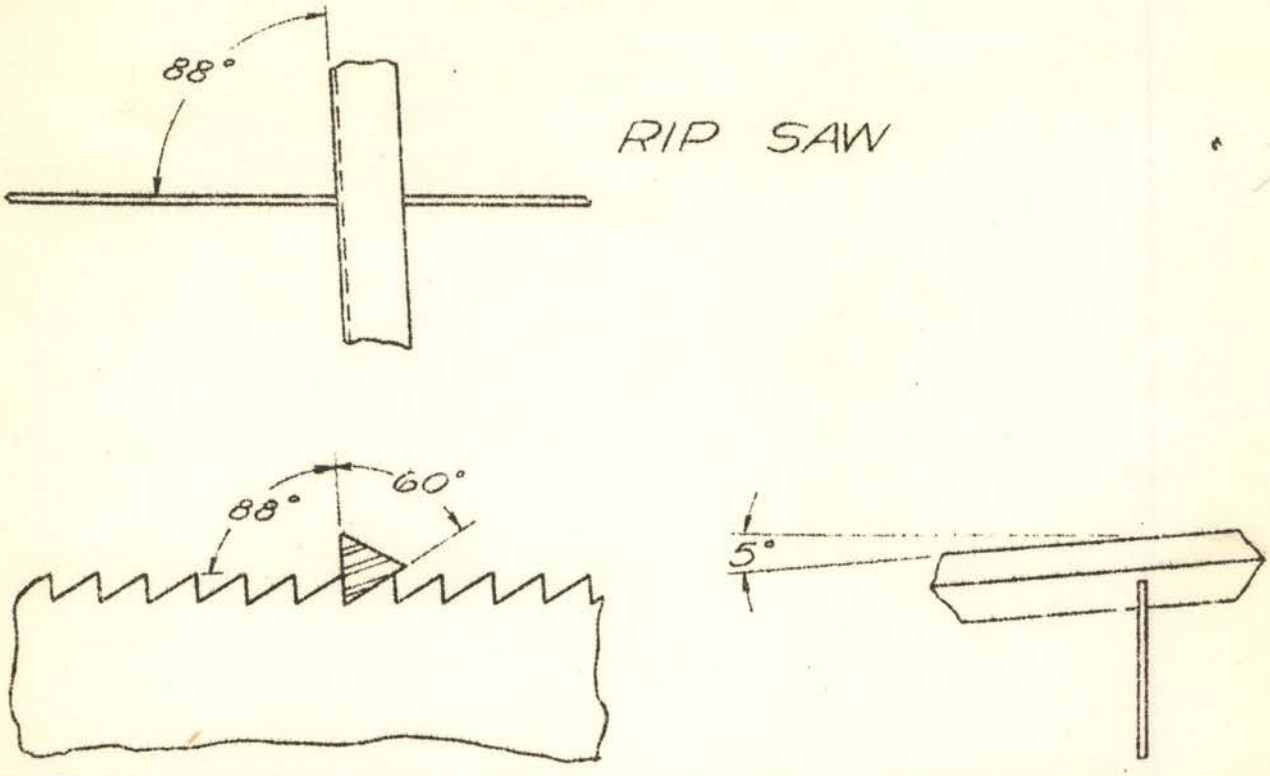
Installation: Place the stones on a shelf or a bench away from the other machines but near the grinder. Leave enough space so pupils will be able to work at both places at the same time. A good place to put the grinder and the oilstones is near the tool room. Nail quarter round around the stones to keep them in place as is shown in Figure 2.

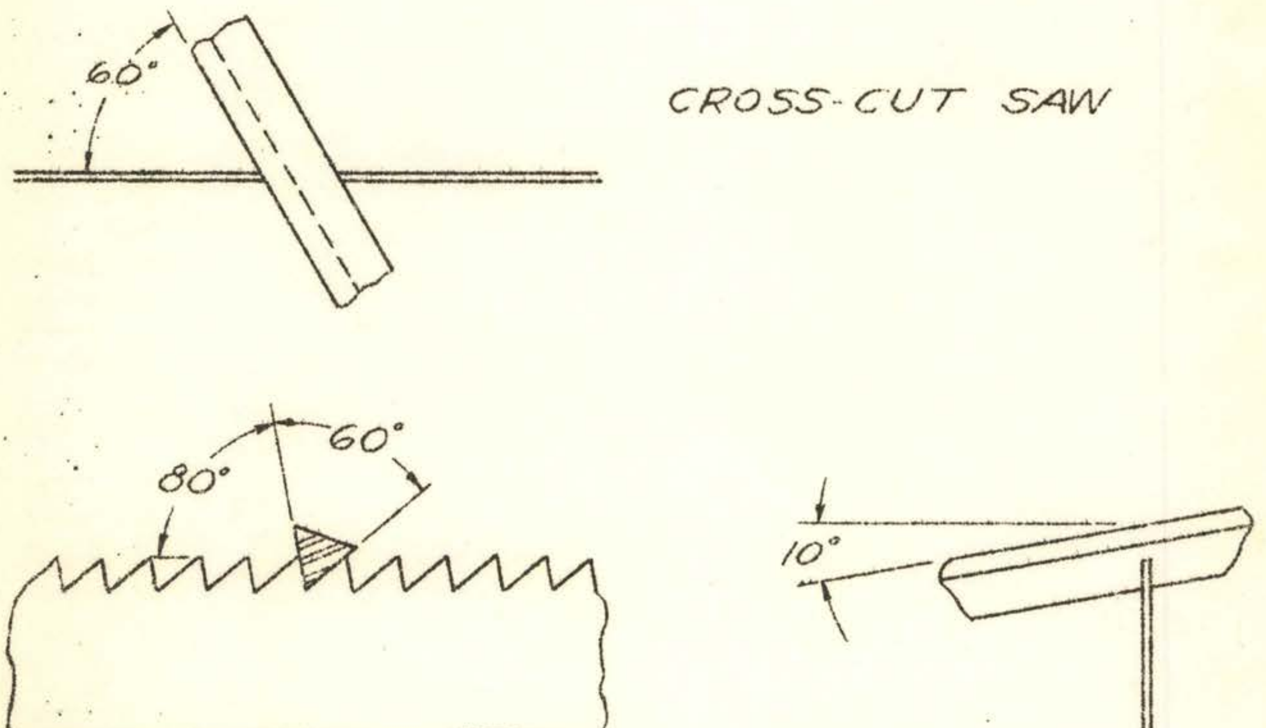
Care: The best oil for an oilstone is a mixture of a good grade of oil and kerosene. Mix the oil and kerosene, using one part of oil to one part of kerosene. A stone should be kept clean and moist at all times. To let it remain dry or exposed to the air for a long period of time tends to harden the stone. The dirty oil should be wiped off with a clean rag after using. Put a few drops of clean oil on the stone and cover with a little box. Use the entire surface of the stone to prevent uneven wear and hollowing out in the middle. Oil should always be used on the stone to prevent glazing caused by particles of steel being forced into the stone, also as a coolant to avoid heat caused by friction. Do not use heavy oils or greases which will fill the pores of the stone and slow its cutting action. If the stone becomes glazed or gummed up, a good cleaning with benzine or ammonia will often restore its cutting qualities. If the liquid does not clean the stone, use a piece of abrasive paper or cloth.

Figure 3

To True the Surface of an Oilstone. Put some valve grinding compound on the true face of a cast iron plate and rub the stone over the iron. The compound will cut the stone and the cast iron will remain true and will thus true the surface of the stone.

METHOD OF FILING HAND SAWS

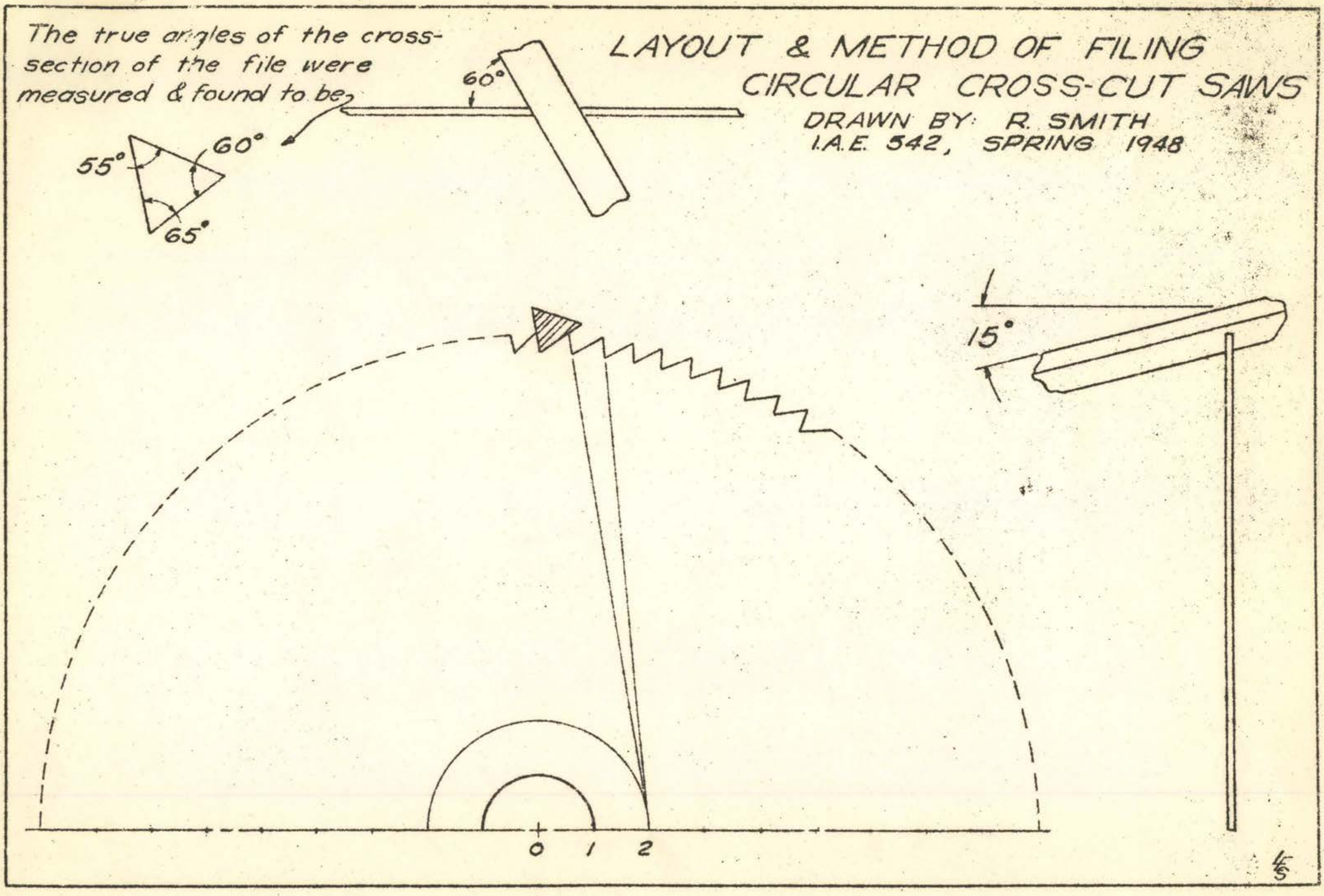




Size of files to use: Back or hand saw; file should be about $\frac{1}{16}$" wider than the longest side of any tooth.
Examples: Use a 6" or 7" double extra slim taper on a 6 pt. rip saw. Use a $4\frac{1}{2}$" double extra slim taper on a 14 pt. back saw.

LE

Plate 4



The true angles of the cross-section of the file were measured & found to be
55°
60°
65°
60°
LAYOUT & METHOD OF FILING
CIRCULAR CROSS-CUT SAWS
DRAWN BY: R. SMITH
I.A.E. 542, SPRING 1948
15°
0
1
2

Plate 5

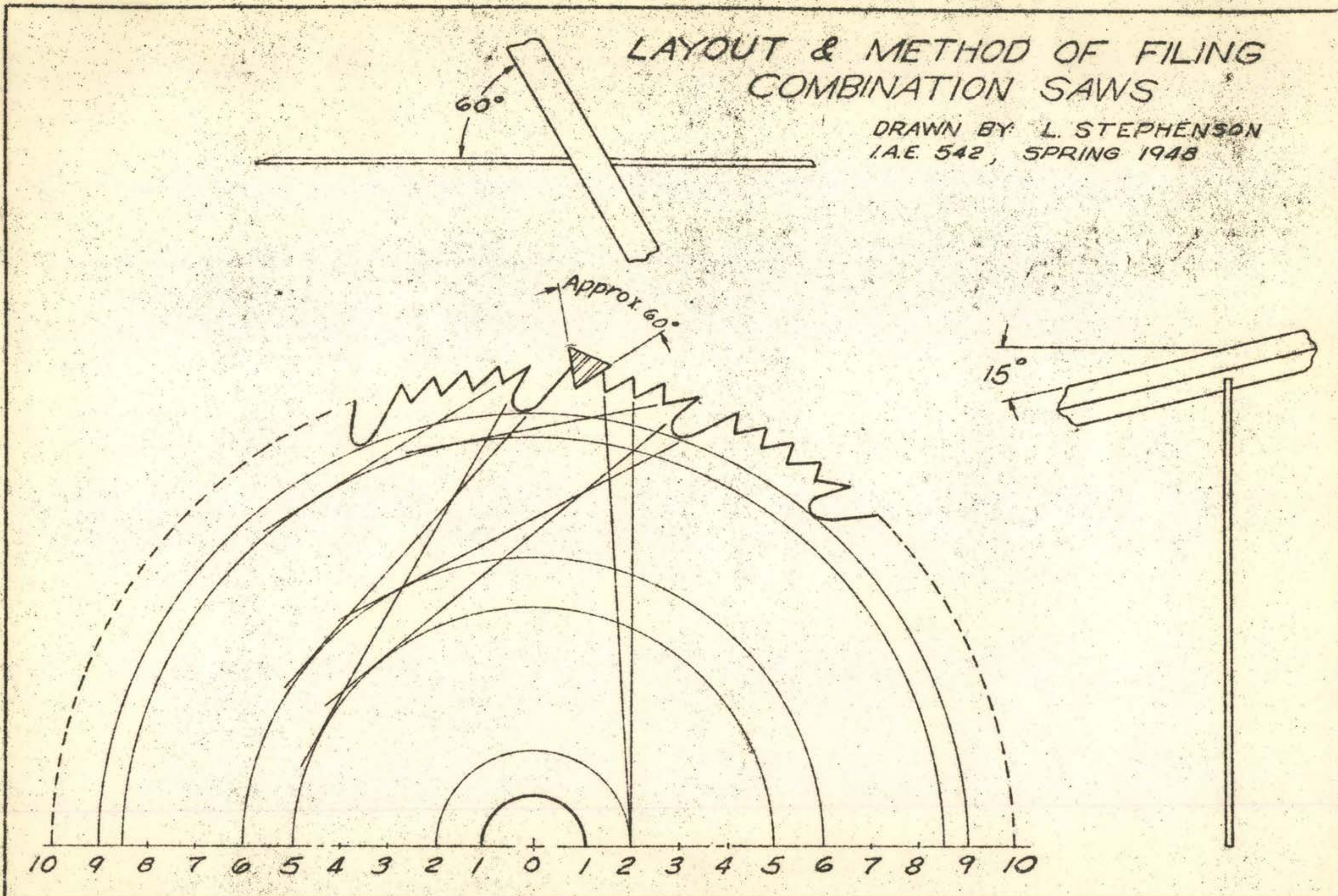
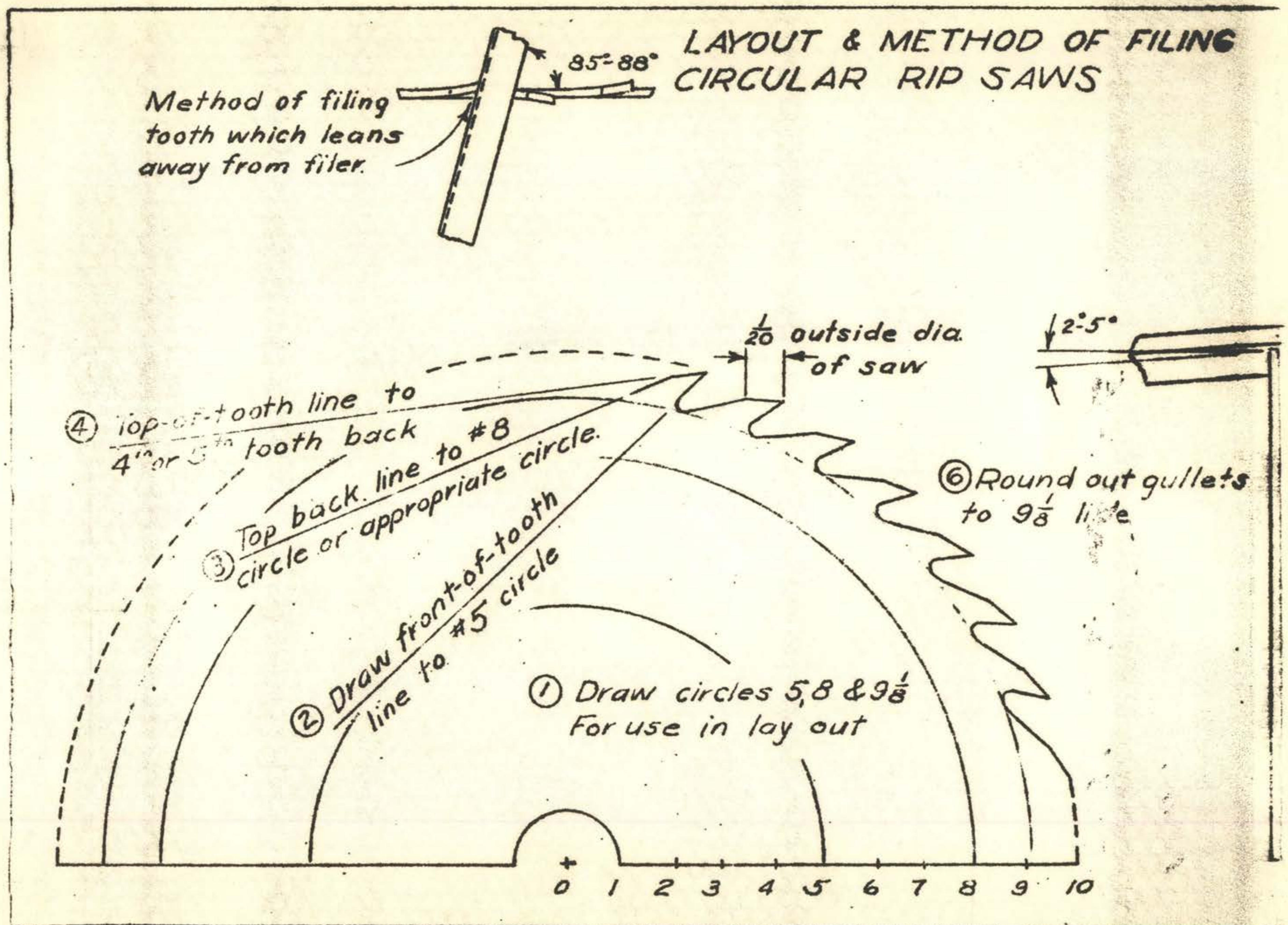
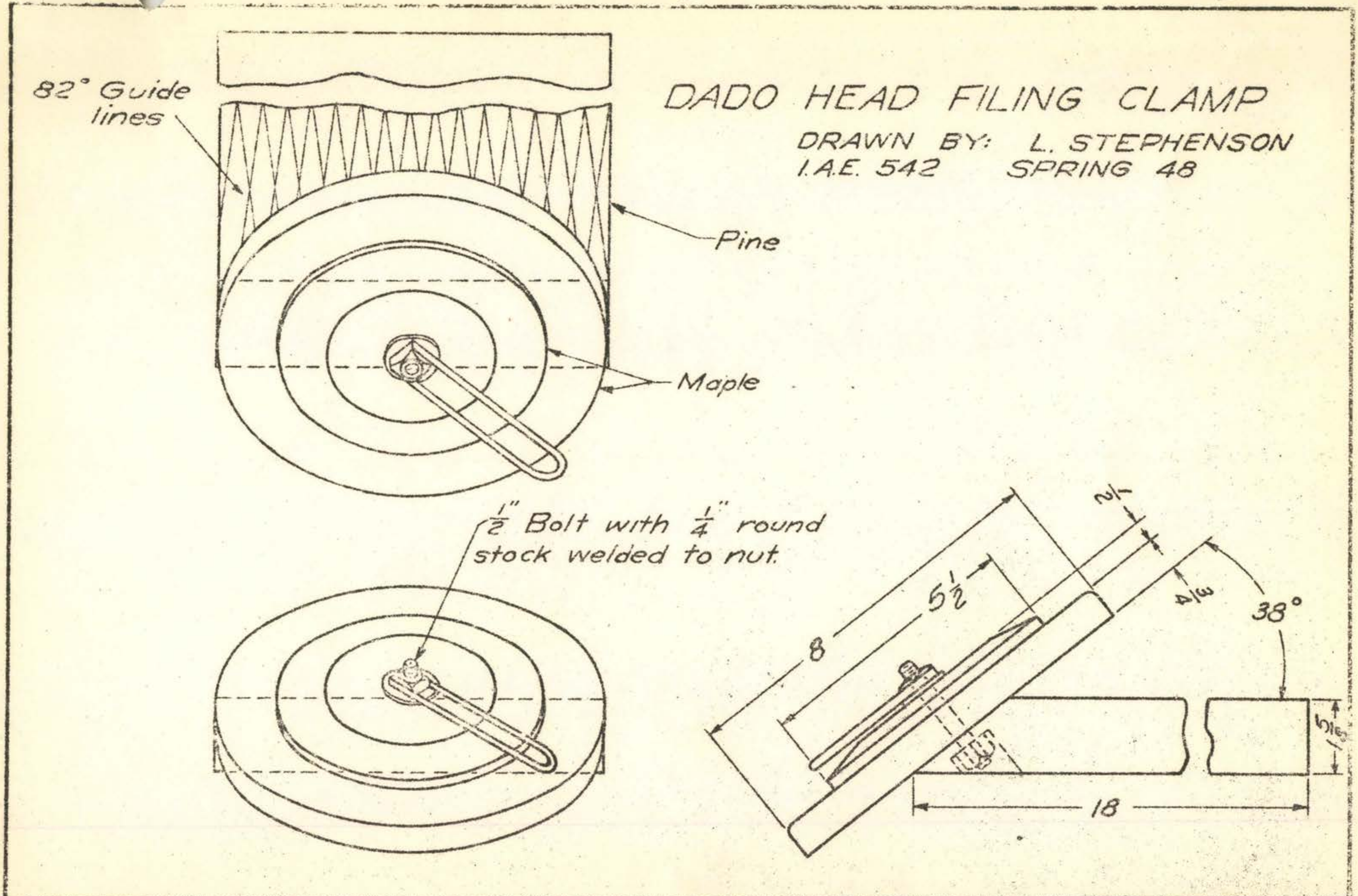

LAYOUT & METHOD OF FILING
COMBINATION SAWS
DRAWN BY: L. STEPHENSON
I.A.E. 542, SPRING 1948
60°
Approx. 60°
15°
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10

Plate 6



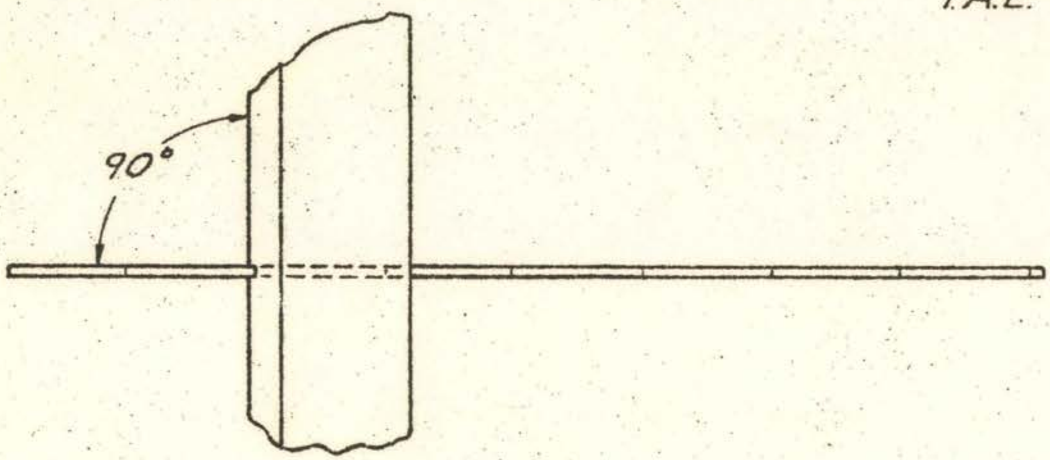
LAYOUT & METHOD OF FILING CIRCULAR RIP SAWS
Method of filing tooth which leans away from filer.
85°-88°
1/20 outside dia. of saw
2°-5°
④ Top-of-tooth line to
tooth back
③ Top back line to #8 circle or appropriate circle.
② Draw front-of-tooth line to #5 circle
① Draw circles 5, 8 & 9 1/8 For use in lay out
⑥ Round out gullets to 9 1/8 line
0 1 2 3 4 5 6 7 8 9 10

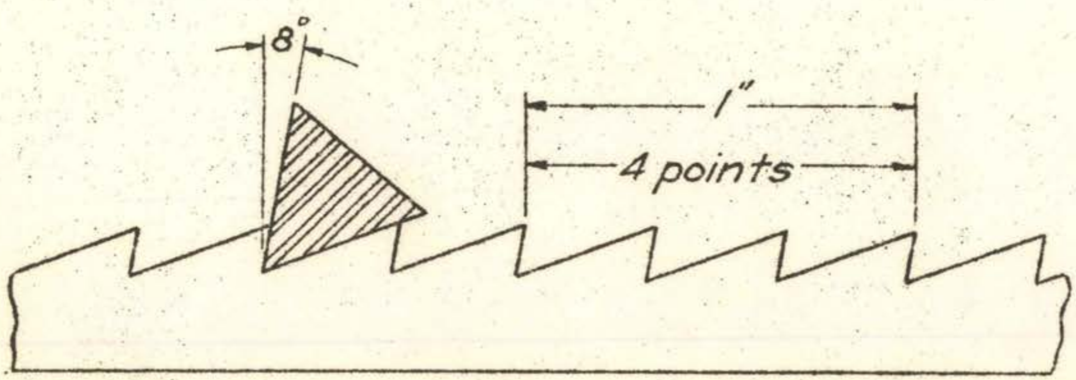
Plate 7


82° Guide lines
DADO HEAD FILING CLAMP
DRAWN BY: L. STEPHENSON
I.A.E. 542 SPRING 48
Pine
Maple
1/2" Bolt with 1/4" round stock welded to nut.
8
5 1/2
1/2
3/4
38°
1 5/16
18

METHOD OF FILING BAND SAWS

DRAWN BY: J. CHUMLEY
I.A.E. 542, SPRING 1948





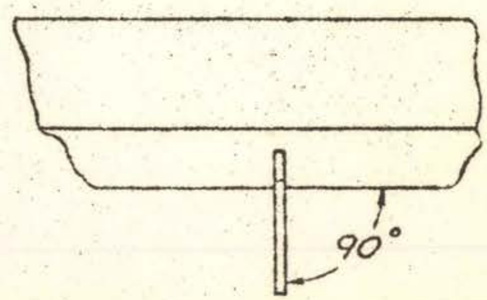
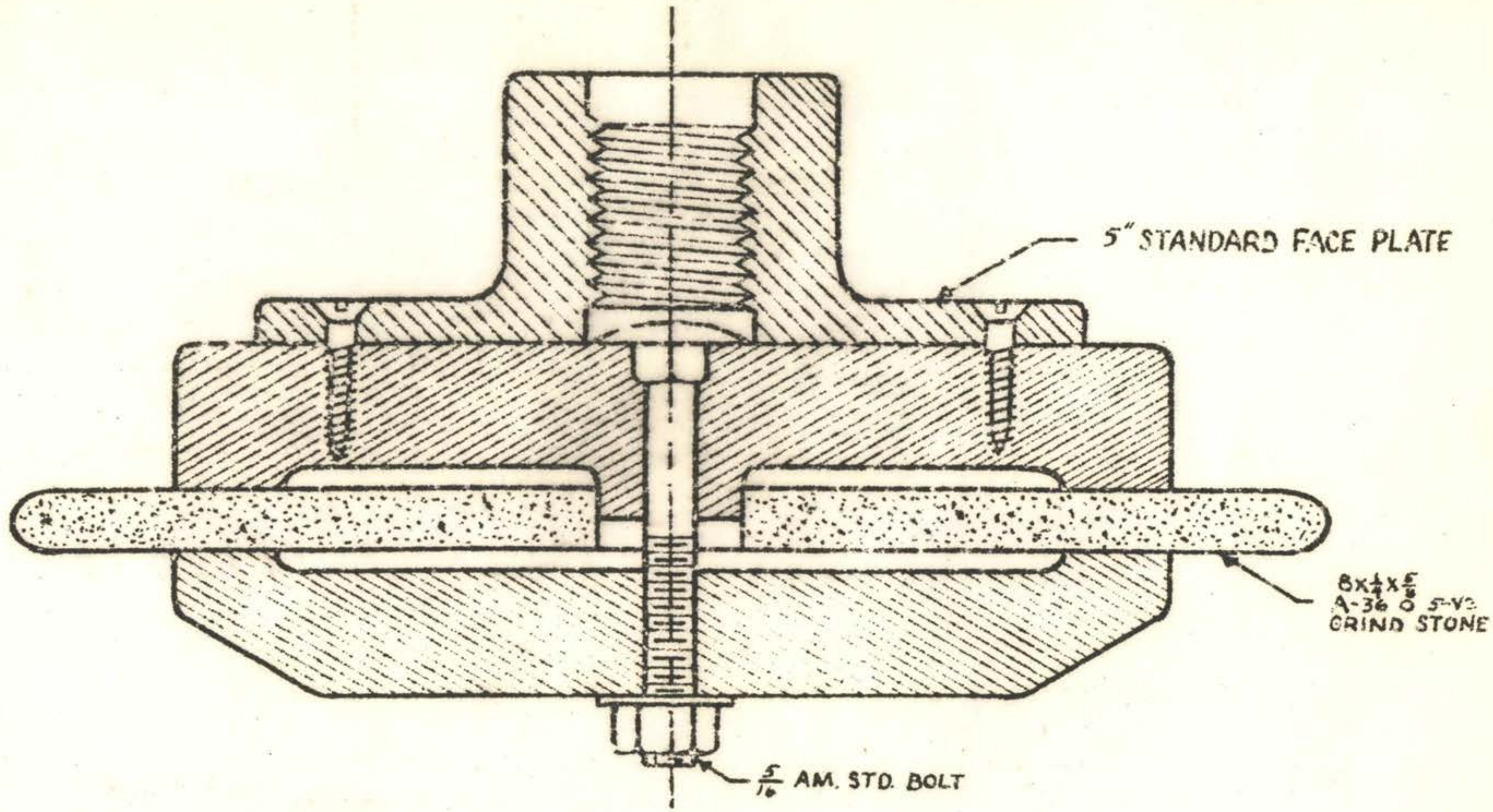


Plate 9



A SAW GUMMING DEVICE FOR USE ON A WOOD TURNING LATHE

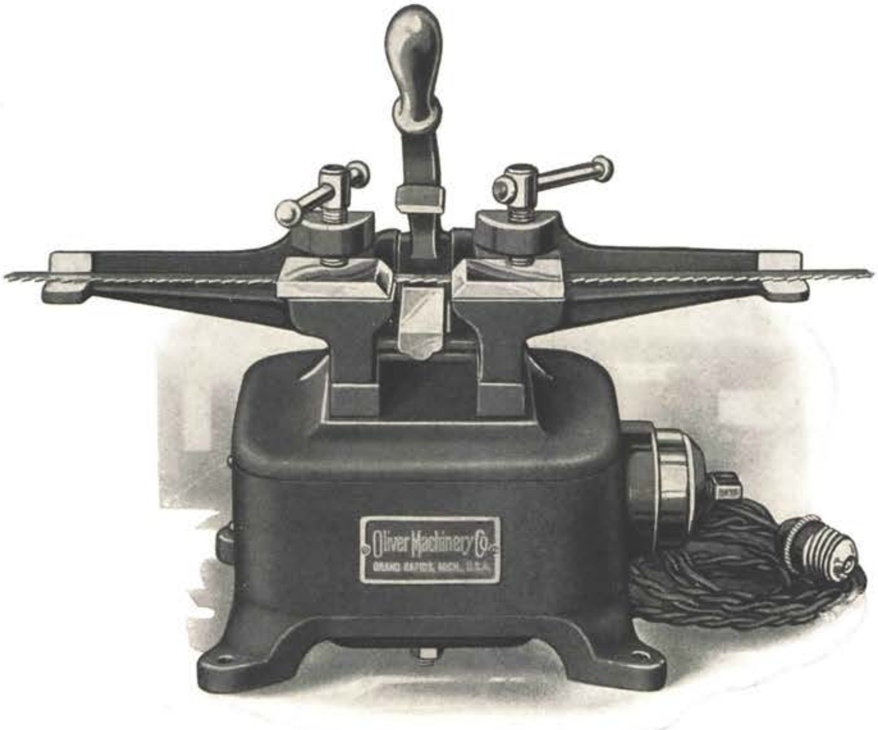
THIRD ANNUAL OKLAHOMA STATE INDUSTRIAL ARTS CLINIC

Plate 10

"Every User Is a Booster"

Directions for Using the "Oliver" Band Saw Brazer

For Band Saw Blades



No. 462 "Oliver" Electric Brazer — Ready For Use.
No. 462-A for saws $1\frac{1}{2}$ inches and less in width.

Plate 11

General

The Brazing outfit comprises a transformer, the main coil of which is connected to a power or light current by means of a switch, and a secondary coil which serves as a clamp for the ends of saw, which are held rigid by screw clamps.

A hand-operated pressure device clamps the ends of the saw together firmly, this clamp being applied when the solder has melted and the saw is at proper brazing temperature. Turn off the current before applying the clamp.

On the No. 462-A Brazer this pressure device is a hawkbill or hand lever arrangement working from above and below the blade.

Electric Current

Be sure that the electric current employed corresponds in voltage, etc., with specifications stamped on Brazer. Damage to the apparatus is improbable unless used on a wrong current. The Brazer requires from 6 to 12 amperes for saws up to a width of $1\frac{1}{2}$ inches. Fluctuations of current from standard, if not more than 10 volts will have no influence upon the good working results, but if the voltage is materially reduced the production of heat will be lessened and the brazing impaired.

Preparation

Prepare the saw for brazing in usual manner, as follows: After the saw has been cut and the ends lightly hammered straight, prepare the laps from $\frac{1}{3}$ to $\frac{1}{2}$ inch wide, and if the saw blade is dirty or rusty, clean both sides with emery

Manufactured by

Oliver Machinery Co.

Grand Rapids, Michigan, U. S. A.

BRANCH SALES OFFICES:

New York, St. Louis, Minneapolis, Los Angeles, San Francisco, Chicago, Denver, Salt Lake City, Seattle, Manchester, Eng.

cloth for about ½ inch back from the lap, to insure a good electrical contact surface. Place the ends of the saw in position with the bevelled ends overlapping and clamp them down so that the prepared laps come directly in the center line of the pressure device. Next place a small strip of silver solder perfectly clean between the bevelled surfaces and large enough to project a trifle all around the prepared lap. Apply powdered borax or rub the braze with stick borax to serve as a flux, immediately on applying the current.

Apply Current

Start the apparatus by turning the switch to point 1. For saws up to ½-inch wide, turning knob to point 1 of the switch will usually develop sufficient heat. The ends of saw, when touching, complete the circuit. No current can flow until the contact is made thru the ends of the saw and the solder. After some seconds the brazed seam will glow and the solder will melt. When cherry red appears, stir or rub the melted solder over the surface of the lap on top, bottom and ends, carefully.

Apply Pressure

Turn the knob back to 0 on the switch and apply the pressure of clamping device. After a few moments, release the pressure device and turn the switch to point 1 again, until a very dark red appears, just long enough to give the saw the proper temper and to avoid having the saw glass hard at the braze. Test for hardness at this point. (Note: The switch may be turned in either direction forward or backward).

Draw Temper

If the braze is too hard, turn on the current slightly until the temper is drawn. Similarly if the saw is too soft, a proper cooling down and tempering of the braze can be obtained by applying the pressure device to the heated surface, immediately after turning off the switch.

Use of Switch

For saws that are 1-inch wide, place switch on point 1, for a few seconds, before advancing to point 2 and when the braze is accomplished return back over to point 1 to 0. On saws 1¼ to 1½ inches wide, of heavier gauge, turn the switch to point 1 for a few seconds, then to point 2 for a few seconds and then to point 3, where it should remain until the solder is melted, and the braze made. At every step of the switch, certain windings of the secondary coil are switched on or off, thus causing an increase or decrease in the degree of heat. A careful distribution of borax flux and melted solder along the edges of the braze will produce a clean braze without scale.

Good Results

Regardless of the size of brazer or the range in gauge or width of the saw, after a few experimental brazes have been made so that the operator has become familiar with the amount of heat developed by each step of the switch, a good braze should, uniformly result.

Caution

When applying the pressure device on saw after the braze is made, the switch should always be at 0. See to it that the hawkbill or main clamp on No. 462-A brazer is in line with saw. This alignment can be adjusted by a set screw located below the clamp in the center of the machine. Keep the faces or surfaces of the clamps that contact with the saw at sides of braze, properly cleaned, by wiping with a clean rag or fine emery cloth.

Safety

Owing to the low voltage, there is no danger from shock.

Repeat

Failure to make a good braze indicates merely a failure to follow directions. In such cases repeat the process and follow the directions carefully.

Finish

After completing the braze and properly hardening same, remove the saw from brazer, lightly hammer over the brazed surface to remove the flux, then straighten and file the surface of the saw on both sides perfectly smooth, leaving no file marks.

Supplies

Powdered borax may be obtained at any drug store. Silver solder ½-inch wide may be ordered from us.

For Further Information Write To

OLIVER MACHINERY CO., - - - Grand Rapids, Michigan, U. S. A.

Form P.F. 1825 5000 7-46

DIRECTIONS
FOR USING
Disston Conqueror Swage

Conqueror Swage, showing angle at which die should be placed on tooth.
"H" shows shape of tooth after using convex die.
"G" shows finished edge of tooth after using straight die.

Plate 12

1. File the teeth to sharp edge to fit opening in Tooth Gauge (see illustration below). A gauge is packed in box with each swage.

2. Note, two dies are cut in the head of the swage —one die has flat faces; the faces of the other die are convex in shape. Each die is slotted. The slots protect the fine cutting edge of the tooth.

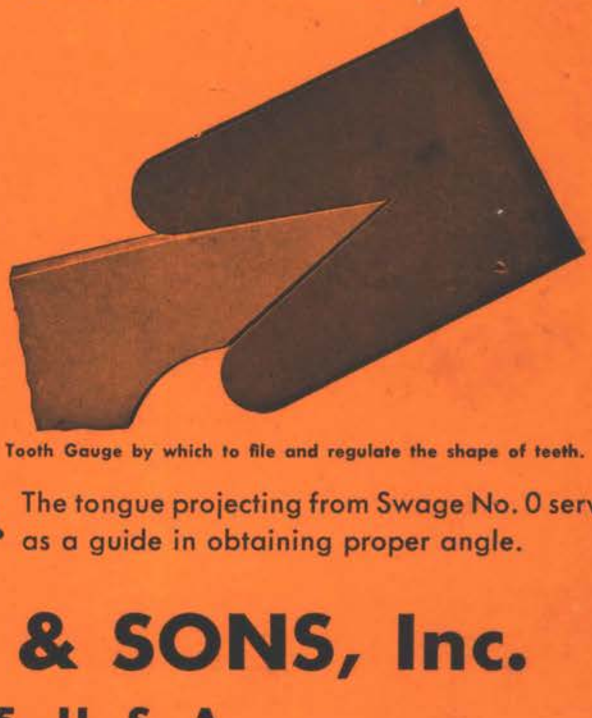
3. Apply oil to the filed tooth and use convex die first. This will spread the tooth, as shown by "H" in illustration.

4. Next, use die with flat faces to square up the point of the tooth, as "G" in illustration.

5. The tongue in center of swage should always be on top of the tooth.

6. In swaging use a light hammer, and do not strike too heavy a blow.

7. Hold swage in proper position so as not to drive point of tooth below cutting line.



Tooth Gauge by which to file and regulate the shape of teeth.

8. The tongue projecting from Swage No. 0 serves as a guide in obtaining proper angle.

HENRY DISSTON & SONS, Inc.

PHILADELPHIA 35, U. S. A.

DISSTON Conqueror Swage

[JUMPER or UPSET]

The Disston Conqueror Swages are manufactured from a specially prepared Disston-made tool steel, and hardened by the Disston process. The band, which is driven on the head of the swage to reinforce it and facilitate work, is made of a high-grade band steel (blue finish) of sufficient tensile strength to withstand reasonable strain.

Two dies are cut in the head of the swage—one die has flat faces; the faces of the other die are convex in shape.

The bottom of the dies are slotted. This protects the cutting-edge of the tooth.

The sides and jaws of the swage are bright finished.

The octagonal wedge-shaped shank was designed for a comfortable, natural grip.

The Conqueror Swages are made in four sizes—Nos. 0, 1, 2, and 3. Packed one swage and one tooth gauge in card-board box. **Actual-size illustrations below.**

DIRECTIONS ON OTHER SIDE

No. 0 For Saws 5 to 9 gauge.

The projecting tongue shown in No. 0 Swage acts as a guide in obtaining the proper angle when swaging.

No. 1 For Saws 6 to 9 gauge.

In the illustration of the No. 1 Swage part of the band is removed to show inside construction of the Disston Conqueror Swage, and to illustrate process of swaging. See complete directions on other side.

No. 2

For small Circular and Mill Saws, not heavier than 10 gauge.

No. 3

For small Circular and Band Saws not heavier than 15 gauge.

File Sizes For Handsaws

Robert W Helsel Fall 1949

Purpose.

To show the sizes of triangular tapered files and the best size to use for a particular saw filing job.

Reference:

Five leading file manufacturers were chosen from which to obtain information; Delta, Simonds, Atkins, Disston, and Nicholson.

Table 1 File Sizes

Length of Files in Inches	Types of Files: Taper	Slim Taper	Extra Slim Taper	Double Extra Slim Taper
4"		1/4"	3/16"	5/32"
4½"		1/4"	7/32"	11/64"
5"		5/16"	7/32"	3/16"
5½"			1/4"	
6"	1/2"	3/8"	9/32"	7/32"
7	9/16"	13/32"	11/32"	1/4"
8	5/8"	1/2"	9/32"	5/16"
9		Not made		
10	3/4"	19/32"		

Table 1 shows the types of triangular tapered files and the maximum side size of each with respect to the length. These file sizes are all registered with the Bureau of Standards of the United States. These files are not a precision tool and will therefore have a slight plus or minus tolerance.

In selecting a file, choose one that has a side width of approximately one and one-fourth times the longest side of any tooth on the saw to be filed

Table 2 Files To Be Used

No. of Points	Taper	Slim Taper	Extra Slim Taper	Double Extra Slim Taper
4-4½	6"	7" or 8"		
5-5½		6" or 7"	8"	
6-7		5" or 6"	6" or 7"	8"
8-9		5"	5½" or 6"	6" or 7"
10-11			5"	6"
12-13-14				4" or 4½"

The longest side of a tooth on both the rip saw and the crosscut saw was measured and the size of the proper file to be used for a particular filing job was determined. Table 2 Shows the suggested files to be used in filing the various rip and crosscut hand saws.

Plate 13