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SAWS,

HOW TO

STRAIGHTEN AND GUM

ALL KINDS.

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SAWS;

HOW TO

STRAIGHTEN AND GUM

ALL KINDS.

BY

A. E. WILBUR,

ONEONTA, N. Y.

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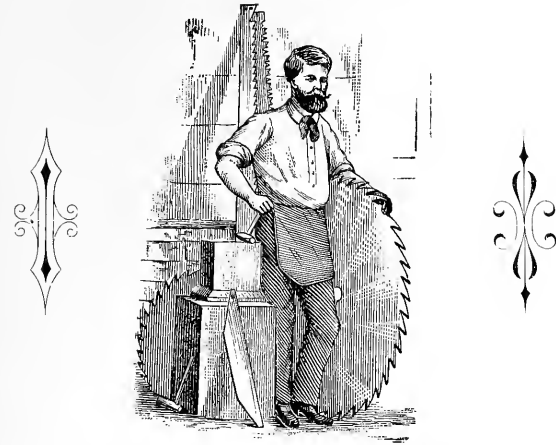
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INSTRUCTIONS

— ON —



Straightening and Gumming Saws.

Owing to a universal want among mill-men for a plain, practical and comprehensive treatise on the art of straightening saws, the author has, in the following pages, endeavored to set forth the general principles by illustration so that any mechanic of ordinary ability can by diligent practice do that class of work which needs to be done in mills using circular and other kinds of saws.

Many attempts have been made to give the users of saws full directions by which they can do their own smithing, but many of them have fallen far short of what they intended to accomplish. Although the author of the following pages does not claim that a "green" man can take up this particular trade, and by the aid only of these pages get to be an expert in a very short time; he does claim that by close application of principles herein shown, he can quickly be enabled to do good and practical work. All experienced millmen will allow that if they could properly hammer their own saws it would not unfrequently happen that they could effect a great saving in time and expense by doing this class of work themselves.

The mill-owner's best friend is a true working saw. If he has good machinery and good, practical men to operate and keep in order he will find that the quality of his work will soon have favor in the lumber market where competition is very strong and good work favored at the present time.

The gumming of saws is often entrusted to inexperienced men who, by their inability to properly do the work, cause the plate to become out of true and unfit for practical use until further repairs are made upon it which oftentimes cause much unnecessary delay and loss of time that

might be obviated had the operator had proper instructions placed before him. To chamber the teeth upon a good and true plate without effecting its tension is a feat that requires much knowledge on the part of the operator as to the effect given the plate by the action of the cutter or gummer.

The writer in the following pages has striven to give sawyers and other mechanics, to whom this class of work may come, full and plain instructions in this branch of saw repairing, and if the rules and principles herein given be well followed, the result will be highly satisfactory.



THE SAWYER to operate successfully a circular saw must observe the following points: The plate should have a tension adapted to the speed applied; it must be free from flaws, blisters and kinks; its teeth must have sufficient room to carry the dust from the kerf; it must be filed and swaged properly; it must have the teeth formed so as not to "heel" when in the cut; its width of kerf must be governed by the condition and kind of timber to be sawn; it must be perfectly round and in balance; its mandrel must run cool and have a slight end play; it must be in line with the carriage and stand perfectly plumb and at right angles to the bed of its head-

blocks; it must not be crowded between the guides; it must not have a feed stronger than it can work under; it must have power enough applied to maintain an equal speed the whole length of cut; it must be favored in large knots and in timber that has a tendency to spring and bind the plate.

Although the log band saw is coming largely into use it will not, on account of its large expense, more difficult management and slowness of feed, displace but comparatively few of the many hundreds of circular log-mills now in use. Owing to the great improvements of late years in the manufacture of saws their quality has largely been improved while their cost has been somewhat reduced by many factories of this country. Natural gas for heating, pressure disks used in tempering, and improved machinery for grinding and polishing are among the most important improvements now adapted.

The purchaser of a new saw should exercise much care in his selection as there are on the market goods of this class varying in quantity like other wares manufactured and sold. Usually a trial of thirty days in actual use is the best test of truth in all form of saw plates.

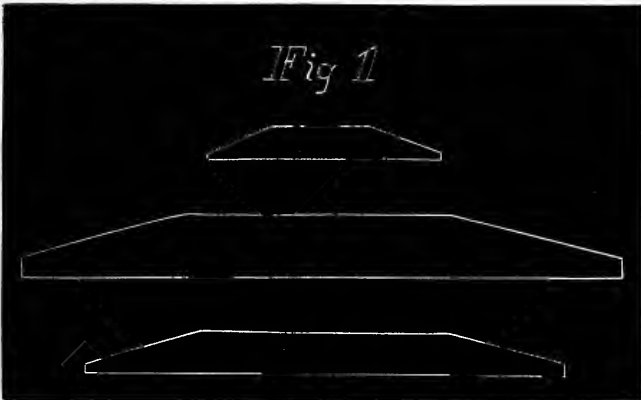
Description of Tools.

STRAIGHT-EDGES.

To straighten a saw of any kind but few tools are needed. By referring to Fig. 1, you will find illustrated three sizes of steel straight-edges that are used in doing work of this class, as well as in factories and general repair shops. The largest size is forty-eight inches long, three inches wide, seven gauges thick, tapered at the ends and planed on both edges. This size is used principally in tensioning saws on their mandrels with burr tightened and guides in place. It is also a very handy tool about the mill for leveling frames, plumbing uprights, straightening shafting, etc.

The medium size is twenty-four inches long, two inches wide, about twelve gauges thick, and planed on both edges.

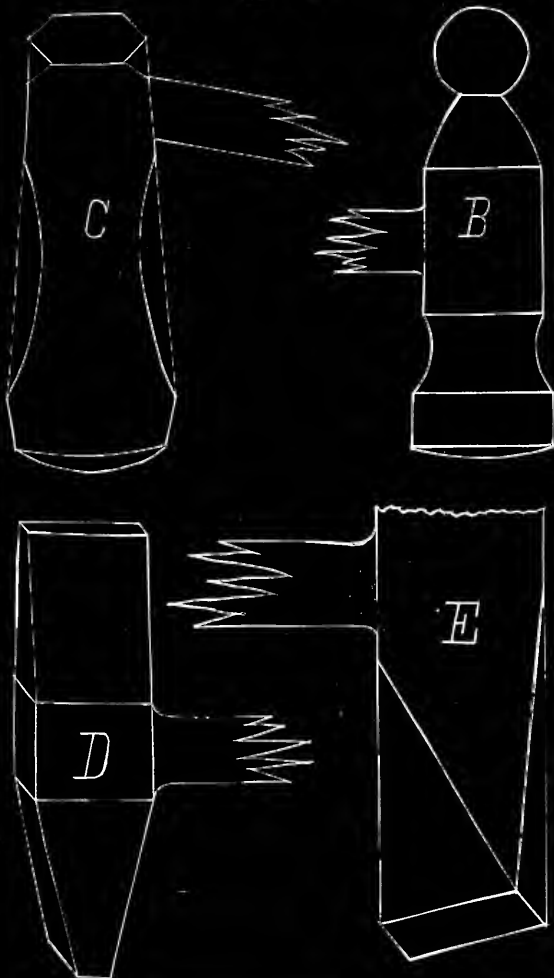
The smallest size is twelve inches long, one and one-half inches wide, tapered and planed in the same manner. These sizes are used on all kinds of circulars, band, mill, cross-cut, drag and gang saws.



Hammers.

For ordinary tensioning, the common pene hammer, shown in Fig. 2 at B, is principally used. This hammer, as well as all of the rest, should be made of good tool steel. The pene hammer should weigh about $2\frac{1}{2}$ pounds, and have its corners and face quite well rounded. At C is shown the form of a dog-head hammer which has a weight of $3\frac{1}{2}$ pounds. It is rounded considerably on the face, and has its handle set at an angle of 80° to the head. The use of this hammer is for stretching unequal places in plates, as its blow is a dead one, being delivered in a direct line. At D is shown a blocking hammer weighing about five pounds. This hammer is made with two faces, one on each end and at opposite angles. The faces are at an angle of 95° to the handle. Thus you will see that the operator can by striking a blow with each end deliver them at right angles without moving the plate or changing his position, and forming by striking one blow over the other a perpendicular cross. Referring to E., another form of blocking hammers is illustrated. This is made the same as the other with the exception that one face is parallel with the handle and the other at right angles. This hammer when used will, on reversing ends, form by its marks on the plate an oblique cross. By the use of these different hammers the smith can deliver just such a blow as he pleases without moving his plate upon the anvil.

Fig 2

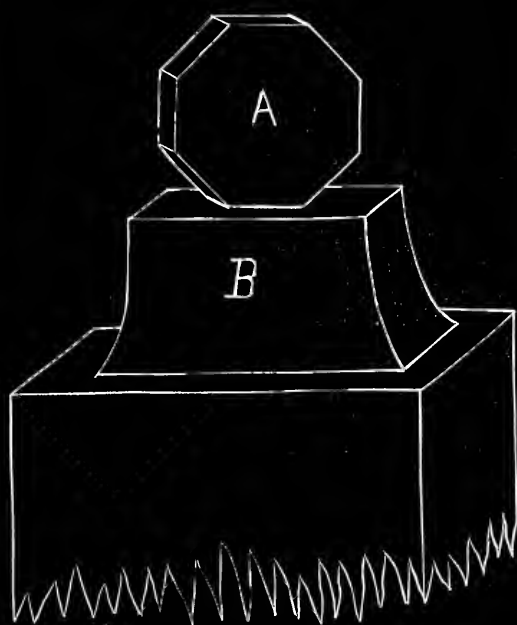


Anvils.

For ordinary mill work the anvil represented at A, Fig. 3, is usually sufficient. This anvil is made of hard cast iron eight inches in diameter, octagon in shape, and about two and one-fourth inches in thickness. It is planed perfectly flat on one side and turned about one-sixteenth oval on the other. In tensioning the larger sizes of circular saws, they are commonly left upon the mandrel, and the hand-anvil held by one hand on the opposite side of the plate from which the operator intends to deliver his blows.

At B is shown an ordinary saw-maker's anvil used in all saw factories and general repair shops. This anvil is made in the form represented with a cast-iron body and a heavy cast-steel face, nicely rounded and polished. Its weight is from one hundred and fifty to two hundred pounds. It should be mounted upon the upper end of an upright post running down through the floor and bedded in the ground with a large stone beneath it. By being thus arranged there is very little spring or re-bound to blows delivered upon the plates lying on the anvil, providing they lay flat upon the face.

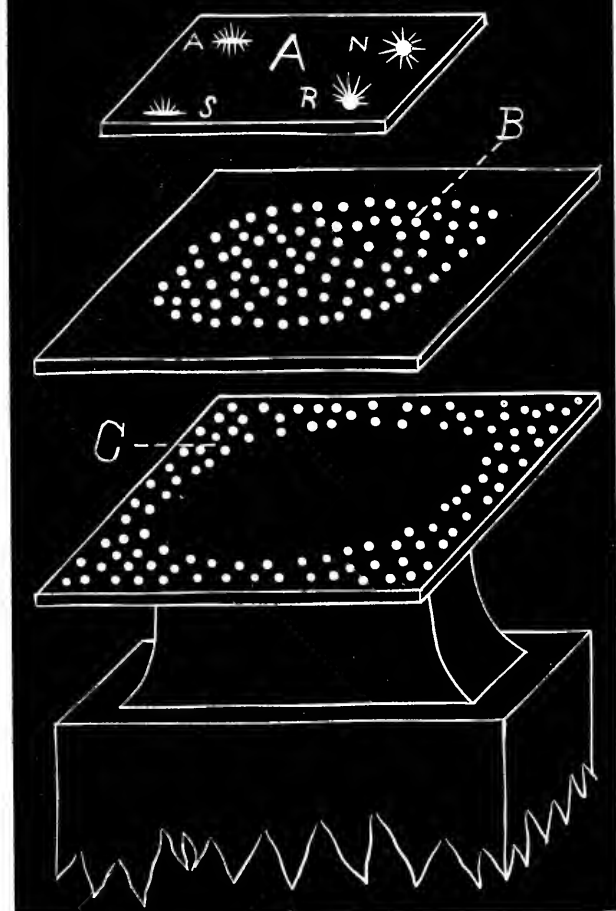
Fig 3



Effects of the Hammer.

Before the smith delivers a blow upon his plate he should know how that blow is going to effect the plate in the locality of its delivery. If he goes at it in any other than a systematic method he will soon find that he is not straightening, but distorting and warping from any and all degrees of trueness. A blow delivered by the round-faced pene or dog-head hammer in a perpendicular line will effect as shown in plate A at N. Its effect being equal on all sides at the point of contact. The same effect takes place by a perpendicular blow as shown at A with the blocking hammer, excepting that which is changed by the form of the hammer itself. At R and S the effect is very much different. This represents a blow falling on a slant, thus producing more expansion beyond the point of contact and in direct line of hammer stroke. In delivering blows upon a saw the smith must pay particular attention to the manner in which he delivers them. Unless the nature of his work requires a slanting blow it is always best to hammer in a perpendicular and direct line. Referring to B, Fig. 4, the effect of many blows delivered by a round-faced hammer on the central portion of a plate is to expand that section, and to accommodate this expansion the plate must dish. It is now out of true and to equalize again to its original tension the section at C must be expanded in order to take up the slack at B. The operator should bear in mind

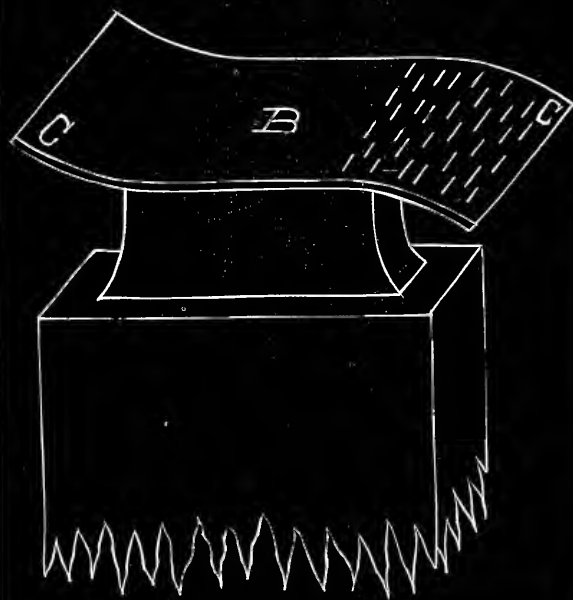
Fig 4



Effects of the Hammer.

that in doing this he must reverse the plate, and do equally as much hammering on either side, otherwise the surface of one side will receive more strain than the other; consequently a true plate cannot be obtained until both are equally expanded. The plate shown at A, Fig. 5, has represented each end bent or sprung from a true line. In order to again straighten the smith should use the blocking hammer and deliver blows as shown on the plate B. The expansion from these blows is nearly all in the line indicated by the arrows shown upon the plate. Referring to plate A, Fig. 4, at S one can readily comprehend why the plate under treatment will soon assume its original form. By delivering the blows from the blocking hammer on the convex side the expansion takes place on the contracted parts of the plate and thus throws it again back gradually in a straight line. The operator must bear in mind that any and all of these principles and methods are applicable to saw plates under treatment. In hammering a plate the operator must use great care and judgment in regard to heft of blows delivered. The quality of steel, different degrees of temper, thickness and size of plates, have all to be taken into consideration. For instance, the smith is hammering a sixteen or twenty gauge saw, he must not use as heavy and strong blows as if he were hammering a five gauge large circular.

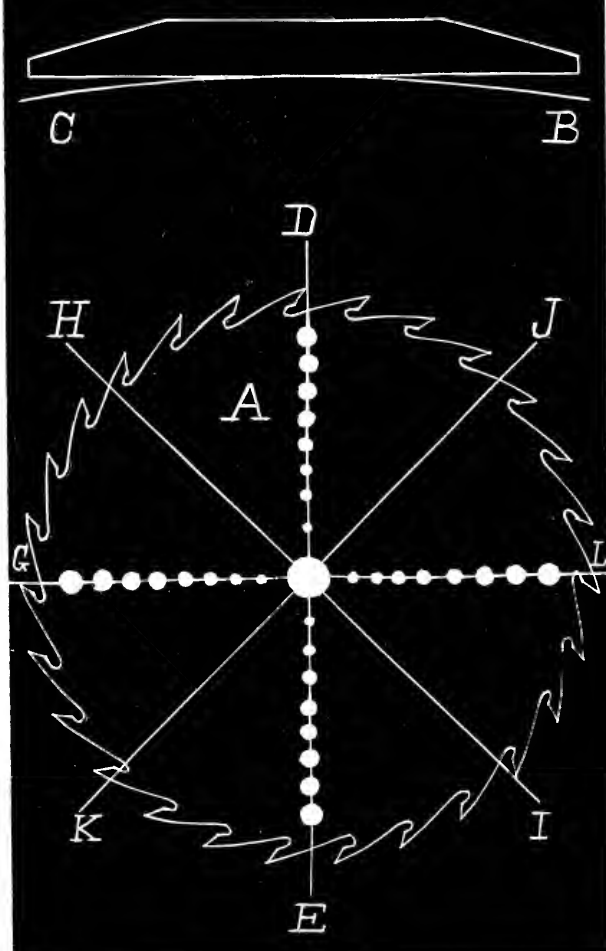
Fig 5



Saw Rim Bound.

A circular saw constantly heated and cooled about the center will soon expand permanently in that locality in such a degree as to cause the plate to become loose, or in other words, out of tension. Referring to Fig. 6, the plate A, represents a rim-bound saw. At B and C is shown how the plate stands off from the straight edge when stood upon one side. A saw in this condition cannot work well as the looseness of the plate will not allow of any but a very slow feed. If the saw be run at a high rate of speed a portion of this slack will be equalized by the expansion due to the speed itself. If the saw be run at a slow rate of speed it should have a tension that will cause the plate to be quite stiff and rigid. In order to equalize the tension on a rim-bound saw, lay it out by marking across the plate with a piece of chalk from D to E and from L to G, then on the opposite side midway between the others, from H to I and from J to K. If the operator wishes to use the hand anvil, leave the saw upon the mandrel with burr tightened and guides loosened. Commencing at the center hold the anvil on one side while delivering blows, at first very light and increasing in heft and force as he approaches the rim. (See represented upon lines drawn across the plate, Fig. 6.) After going over the saw in this manner on all the lines, care being taken not to hammer too much on the concave side, try the plate with the straight edge and if not effected sufficiently draw another set of lines in the same manner between those previously drawn and proceed as before until the rim is sufficiently stretched or expanded.

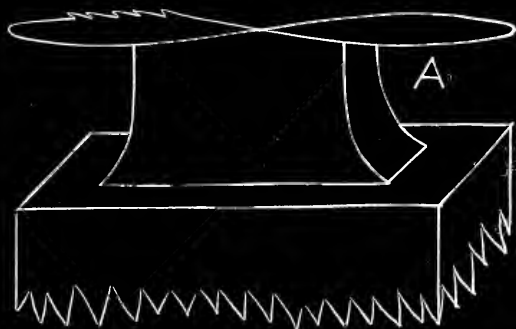
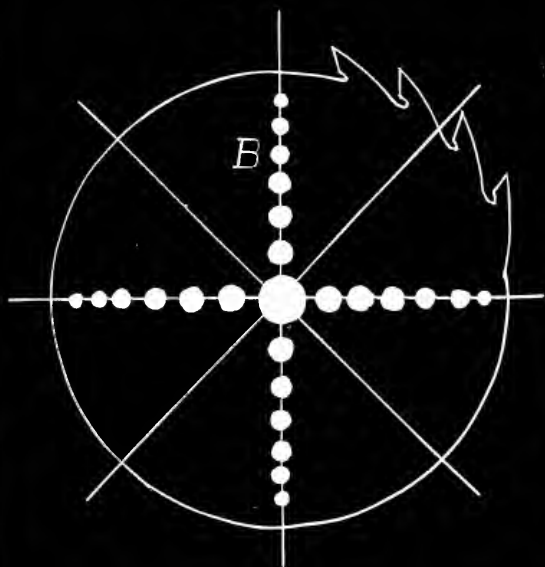
Fig 6



Saw Center Bound.

Usually when a sawyer attempts to run a center-bound saw successfully he finds the trial a complete failure. A saw in this condition cannot be run with any degree of accuracy. It is seldom a solid toothed saw will get in this condition unless it is roughly used while gumming or has been unduly heated at the outer rim. One of the greatest difficulties in running an inserted toothed saw is due to the expansion given the outer edge of the plate by the teeth being sprung or riveted in their sockets. Unless this expansion be nicely adjusted the plate will become center bound, and consequently cannot cut in a straight line. By referring to Fig. 7, at A, is shown a plate that is center bound and one can easily see the form it assumes. In order to correct this, lay the saw out, as shown on plate B, with a piece of chalk, drawing a set of lines as explained on plate A, Fig. 6. Next place the saw upon the anvil, or if the operator choose to use the hand anvil, leave the saw upon the mandrel holding the anvil in the left hand. Proceed by commencing at the outer rim hammering towards the center, very light blows at first and gradually increasing the heft and force as shown by hammer marks on the plate. Go over the set of lines drawn on one side and then reversing go over the other in a like manner. If you have not the desired tension by going over in this manner on both sides then draw a new set of lines between those previously drawn and proceed in this way until the desired tension is obtained. Care should be taken not to over expand the center, causing the plate to become rim bound.

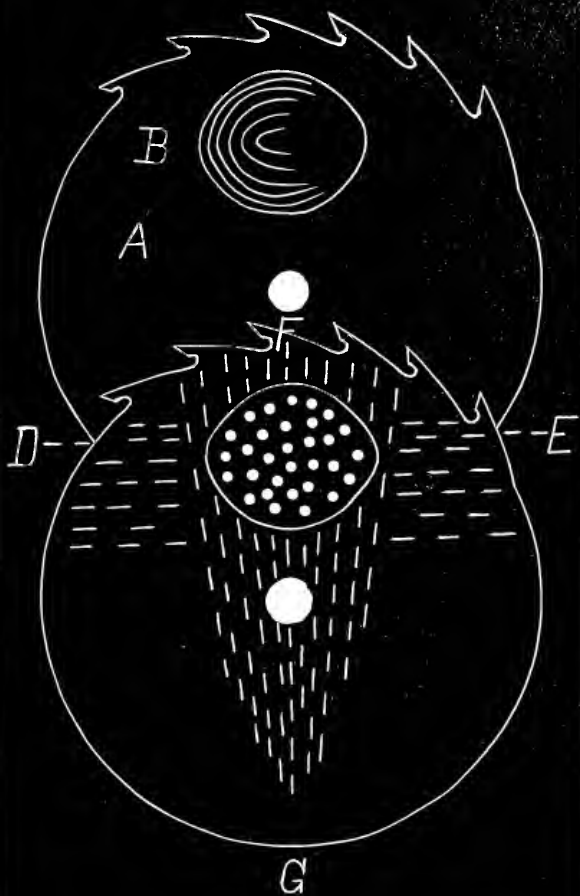
Fig 7



Saw Blistered.

This is a common term applied especially to large circular saws that have been accidentally, carelessly or otherwise over-heated and bulged in different places upon the plate. It is evident that a saw in this condition cannot be depended upon for accurate work. The prominent parts of the plate will when passing continuously through the cut come in contact with the side of the kerf, thus expanding more and more by the friction and heat. To remove these loose places the plate must be expanded by the hammer in a locality that will take up and equalize the tension again. By referring to Fig. 8, at B, plate A, you will see represented one of these blisters, and in order to effectually remove it, lay out the plate as showed by the lines from D to E and F to G on both sides and hammer with the blocking hammer as shown, care being taken not to hammer more on one side than the other. This being done deliver a few blows with the round faced hammer upon the convex side of the blister. After trial if it be not all removed repeat the operation until the tension be again equalized.

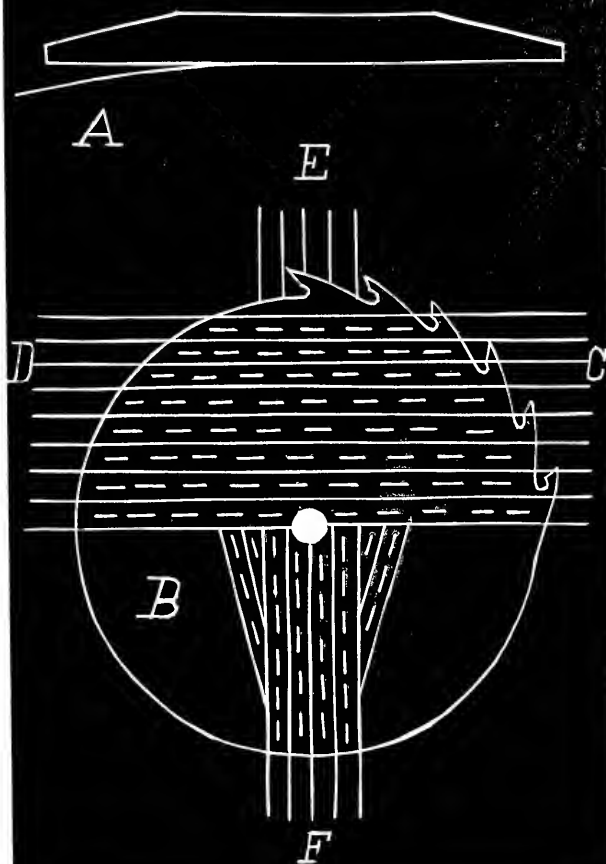
Fig 8



Circular Saw Kinked.

A circular saw bent or kinked is represented in Fig. 9, at A and B. Oftentimes through accident a plate will get bent, sprung or kinked and, as a result, must be straightened before its use can be continued. In order to remedy this, lay out the plate on the convex side as represented by lines C, D, and E F on plate B. The plate is now hammered on the same principle as shown in Fig. 5, plate A, excepting that the form must be largely taken into consideration. On the one a circular plate and on the other a square; but the general principle involved being the same. Hammer as shown on the lines C, D, with the blocking hammer in order to pull the the plate back in line again through the expansion given the underside. By doing this a certain amount of expansion is exerted upon the plate cross-wise and must therefore be equalled by a certain amount given as shown upon the lines E, F. The straight edge should be frequently applied to denote when the required amount be given.

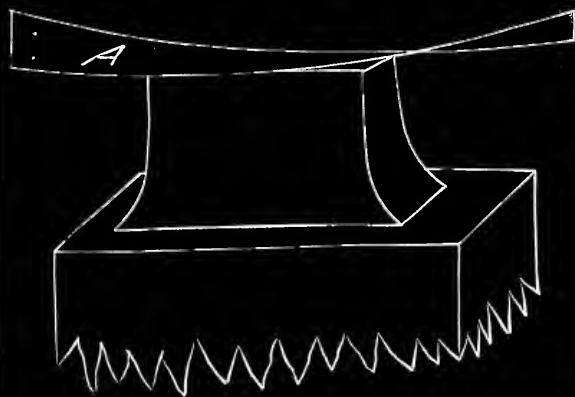
Fig 9



Long Saws.

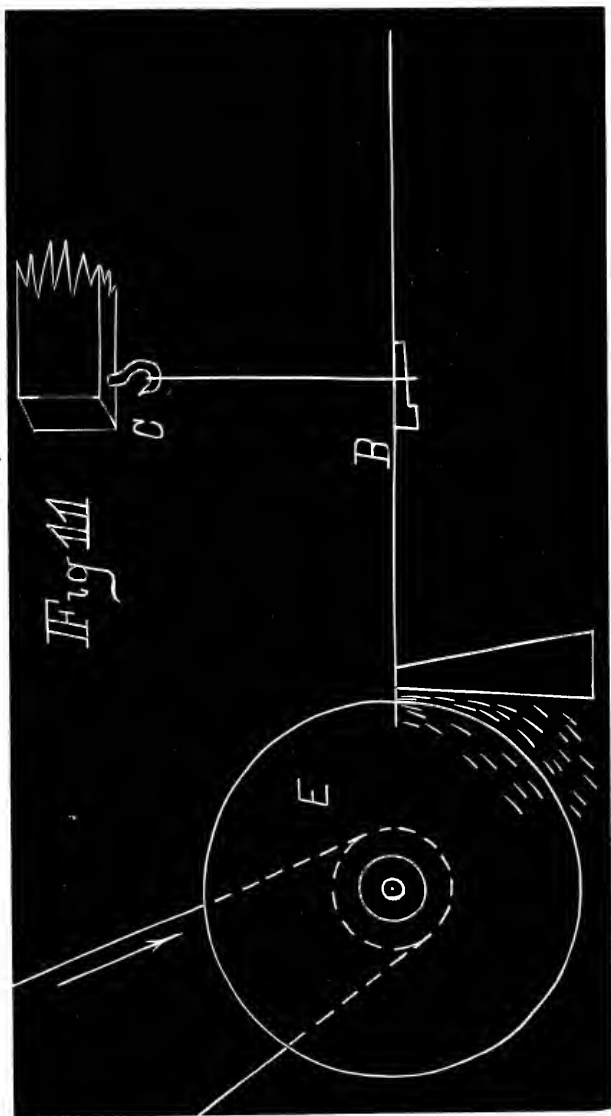
This class of saws, owing to their longitudinal shape or form, and having a reciprocating motion, are usually subjected to hard usage and very frequently become warped, kinked or bent. At *A*, Fig. 10, is represented a long saw having a twist running obliquely across the plate. In order to correct this, lay the saw upon the anvil with drooping corner downward and hammer as shown on plate *B*; when this section be sufficiently raised change ends, reverse sides with the plate, and proceed as before. In tensioning saws that are strained, such as gang, mully, frame and band saws, care should be taken to have the tension well equalized, thus avoiding any looseness in the plate while at work. If the operator be a new beginner in the art of saw hammering, it would be a good plan for him to commence by practicing a short time on a steel or sheet iron plate procured for the purpose. He can thus readily see how his blows effect the plate and will gradually find that he can control its tension wholly with his hammer; then by slowly trying the saw plates he will soon find them quite easily mastered.

Fig 10



Gumming Saws.

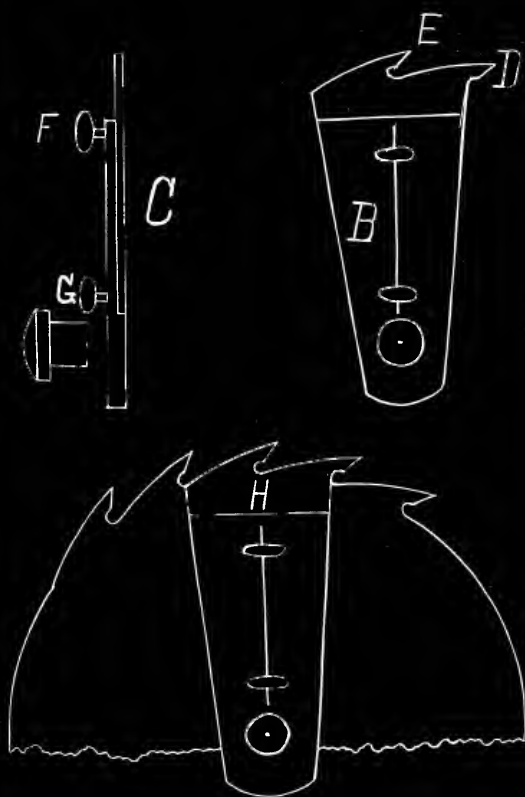
Too much care cannot be exercised in doing this class of saw repairing, as there are more saws crippled by bad gumming than the actual work performed by them. For cutting out or removing the surplus metal from the teeth many kinds and forms of tools have been devised. Although there are a few good and effectual methods of doing this work, there are many that are decidedly objectionable and ruinous to the plates. Some of the best methods used are the stone, emery, and burr gummers. To properly gum a large circular saw with an emery wheel suspend the plate from the center as shown in Fig. 11 at B and C, and support it by a rest built up so as to place the saw in a direct line with the center of mandrel that holds and drives the wheel E. A saw held in this manner allows the wheel to cut square across the plate and thus avoids all tendency to chatter and bound, leaving the seat square and forming a good chamber for dust. The author has used many different makes of wheels, and while some cut slow and heat fast, there are others that cut fast and heat slow; among the latter class a celluloid wheel, by the author's experience, does the work in the best and most satisfactory manner. In gumming, the operator should press the plate quite firmly against the wheel for four or five seconds, and then withdrawing pass on to the next tooth, and in this manner passing around the saw several times before completing.



Balancing Plates.

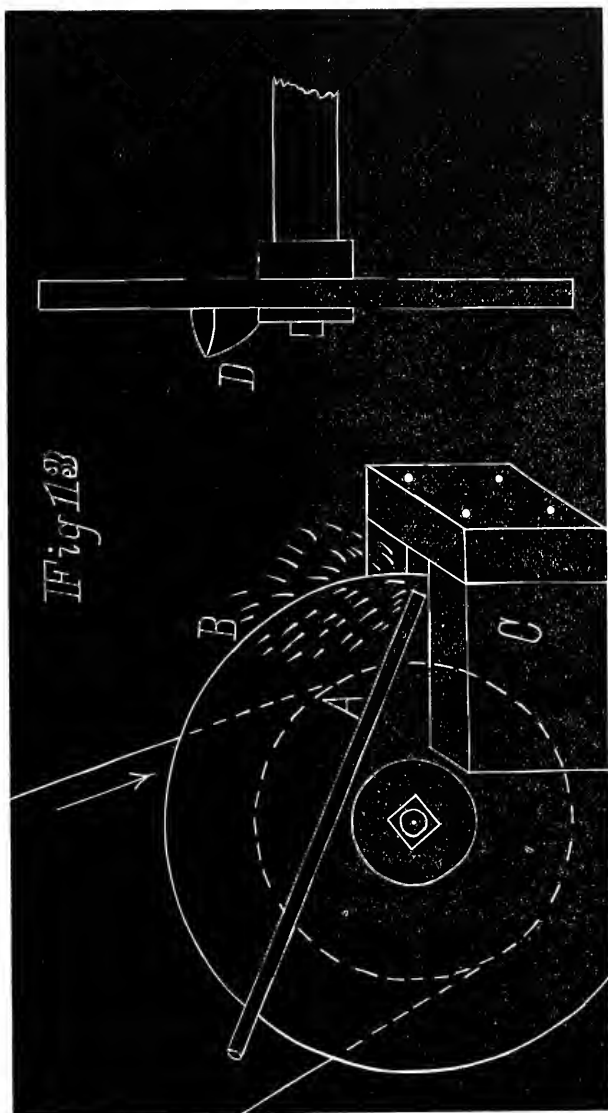
A true plate out of balance cannot run steadily even though its tension be well equalized. By referring to Fig. 12, at B, is shown a template or gauge which if used when laying out the plate for gumming, will keep the saw in good running balance. The gauge is made in two sections, as shown at C, held together by two binding screws, F and G, which allows taking up as the saw wears smaller. At B is shown the general form of the gauge; the lower end is fitted to the center or eye of the saw and upon the upper end is formed the desired shape of tooth. Placing the point D at the point of the lowest tooth upon the plate, mark with a sharp steel point around the form E, as shown at H. Allow the cutter, of whatever form it may be, to displace evenly the metal along the lines. When the saw has been dressed and filed it will be perfectly round and will run well balanced. Long saws may be laid out and gummed upon the same principle, except that the gauge must be made to work wholly from the points of the teeth, there being no center or parallel back to move the gauge from.

Fig 12



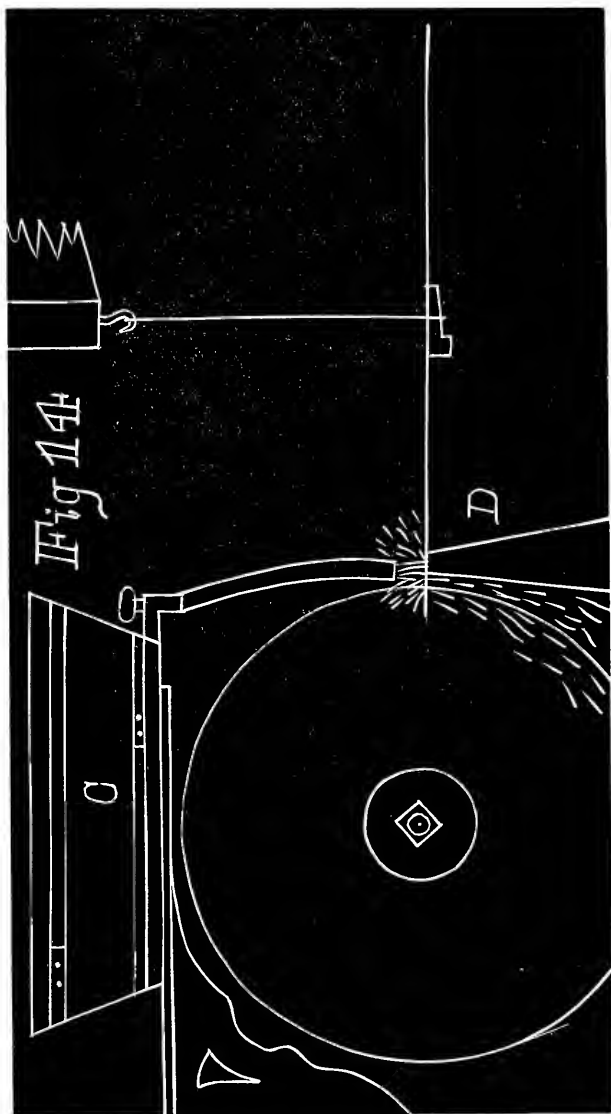
Stone Gummer.

A very cheap and effectual gummer may be made from a common grind stone in the following manner: Procure a stone about twenty-eight inches in diameter, $1\frac{1}{2}$ inches thick, of medium grit and perfectly free from seams, flaws and breaks. Dress it flat with a chisel around the eye in the locality where the mandrel collars come in contact, and cut a groove from center back, clearing the collar to pour the metal through. Place the stone upon the mandrel with a thin hard wood collar in place of loose one, as this with the thickness of the stone will allow the burr to be tightened, holding the stone in position. When all are in place with stone centered as nearly as possible, pack around the collars putty enough to fill all crevices, and build at the end of groove a tunnel, as shown in Fig. 13, at D. Melt a quantity of lead sufficient to fill the vacancy; pour into the tunnel and allow it to cool. The stone is now ready to be turned into proper shape for gumming. Build a rest about the stone as shown at C; allow the stone to revolve at about 125 revolutions per minute, and with a piece of round iron or gas pipe turn off as shown at A and B. The operator should not bear on too hard or allow his tool to catch, as there might be danger of fracturing the stone. It is always best in using a stone or emery wheel not to stand directly in front of it, as it is not necessary and in case of breakage pieces almost invariably fly in a direct line with wheel. With due care and proper treatment however, accidents of this kind seldom if ever occur.



Gumming.

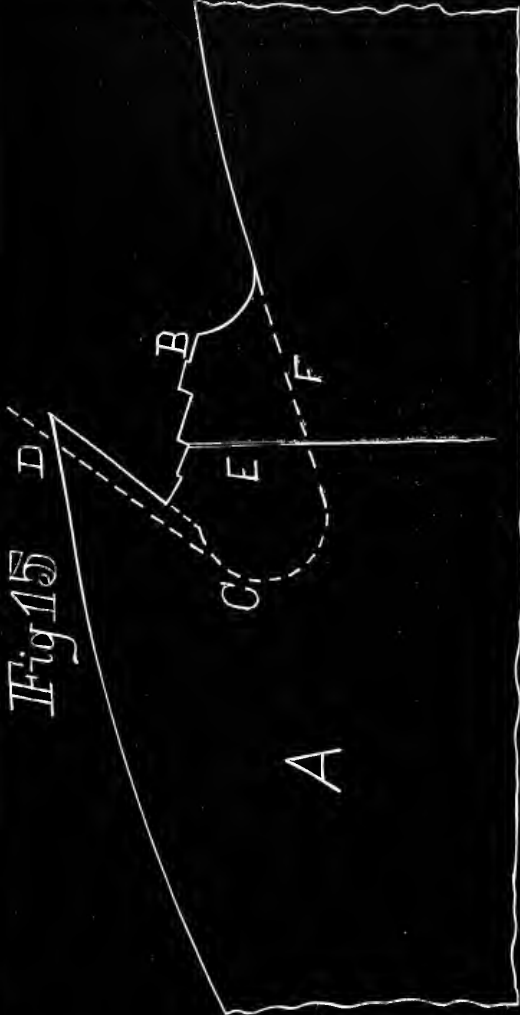
The rapidity with which this form of gummer will cut into steel plate is surprising. By referring to Fig. 14, the general arrangement for gumming a circular saw is shown. The plate is suspended by the center as with the emery wheel, the edge resting upon the support D, a tub of water is placed as shown at C, with faucet and tube connected, directing a stream upon the stone and plate at the point of contact, thus facilitating the cutting action and keeping the metal cool. The stone should be run at about 275 revolutions per minute, and be covered by a wooden or sheet metal covering to prevent water from flying upon the operator while at work. To secure the best results, the rest supporting the saw should be lowered about one inch below the center of the stone, thus cutting a very little obliquely across the plate. The writer has with this form of gummer gummed a large circular saw, cutting out from each tooth about three-fourths of an inch in depth of metal, in less than thirty minutes without injury to the plate. In using this form of gummer care must be taken not to run at an overrate of speed, as the centrifugal force is liable to burst the stone and do much damage. A good burr gummer may be used without injury to a plate if the operator chooses to be at the extra expense, apply his muscle, and follow well the the directions given with the machine. Press gummers should be used only in saw factories.



Teeth Well Chambered.

It is not economy for a sawyer to use a saw without gumming until the throat or sawdust chamber be filled as shown in Fig. 15, at B, plate A. It is obvious that a plate with teeth in this condition cannot stand up under heavy feed, as the sawdust by more than filling its space will crowd itself out at the sides, consume a large amount of power, cause the plate to heat and, as a consequence a poorly sawed lot of lumber will be produced. By frequently gumming and keeping the form of teeth as shown on lines F and C, the liability of stretching the plate upon the rim by cutting out a large amount of metal at one gumming is avoided. Teeth in this form are very easily dressed, as the file has free action by not coming in contact with any of its corners. By producing, with the file, press gummer, or any other device, square corners at the base of teeth, there is danger of the plate eventually cracking, as shown at E. Band saws should be filed or gummed on a circle at the base of their teeth, as the action over wheels tends to bend and crack them in that locality.

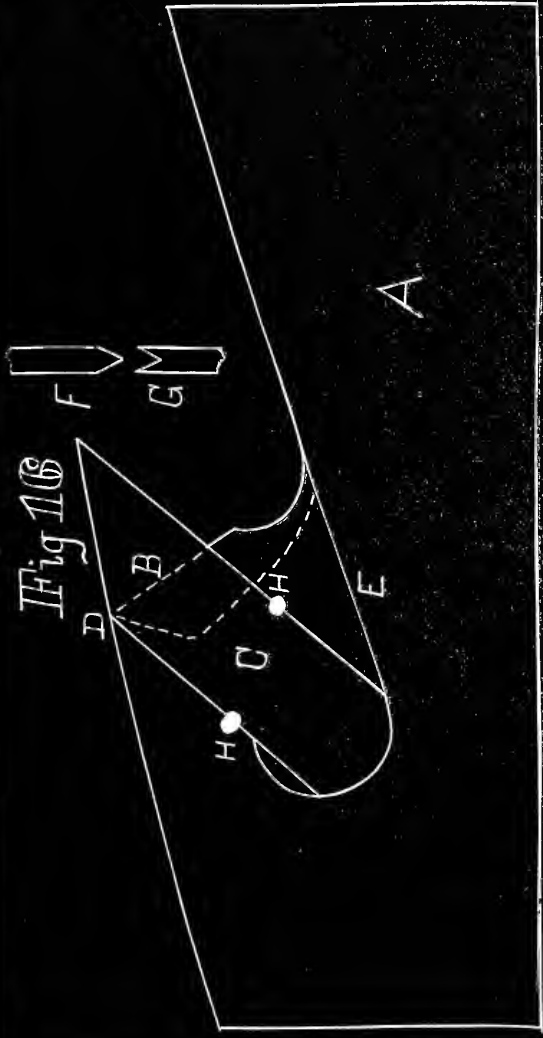
Fig 15



Repairing Broken Teeth.

Unless the operator understands well the art of brazing steel, he should repair a broken tooth by inserting a removable point or tooth accordingly as the shape and circumstances will allow. If broken, as shown on the plate *A*, Fig. 16, at line *B*, the spike tooth, as shown at *C*, is a very good way of repairing the break. As the saw becomes smaller the inserted tooth will soon wear back to the point at *D*, and then by removing the stub and gumming out the metal on the line *E*, a new and perfect tooth is again formed. To insert a tooth of this form, cut the metal out within three-thirty-seconds of an inch from the lines around the tooth *C*. File the edge as shown at *F* in a *V* shape. Form the tooth, *C*, the desirable size and cut a groove around it as shown at *G*; slide it into place, care being taken not to have it fit too tightly, drill two small holes at *H*, *H*, and insert two rivets, countersinking and upsetting them below the surface of the plate. All breaks will not be of the form shown, hence a tooth must be formed and inserted that will be best suited for the occasion. Solid toothed saws may in this way be converted into removable or inserted toothed ones in the same manner by placing the needed tension upon the plate after the teeth are in place.

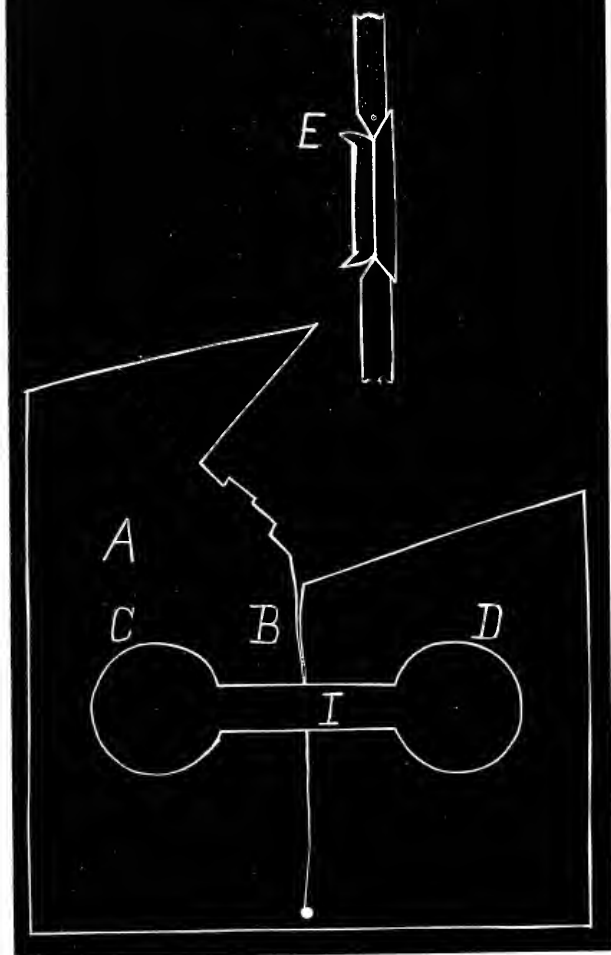
Fig 168



Repairing a Fractured Plate.

If by accident or otherwise a plate becomes fractured at the outer rim extending inward, the break, if not too deep, may be effectually repaired as follows: Trace the fracture to the extreme end and drill a small hole through the plate at that point to prevent it from going deeper or extending farther. Lay out the plate A, Fig. 17, as shown at C, D, across the break B. Drill two $\frac{5}{8}$ inch holes through the plate and countersink them from both sides, thus forming a V about the rim of both sides. Cut out the space I, with an emery wheel or file, leaving the sides square. Form from a plate of wrought iron about two gauges thicker than the saw a dovetail in form as shown at E, that will fill the socket, giving it a slight draw endwise and after heading down put it upon a stone or emery wheel and reduce the thickness to that of the plate. This, if properly done, is a very satisfactory way to repair a fracture of this kind. If a circular plate be cracked near the eye or midway, it should be discarded, as it is unsafe for further use.

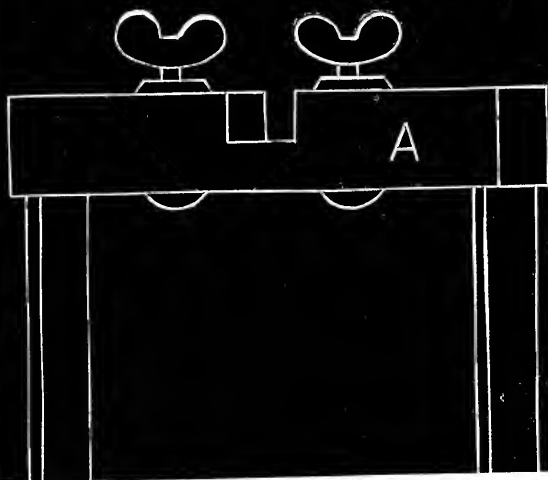
Fig 117



Brazing Band Saws.

At A, Fig. 18, is shown a very convenient form of clamp to be used in brazing band saws. The plate, if it be a large one, should have its ends beveled at least $1\frac{1}{4}$ inches back and be placed in the clamp so as to form the thickness of the plate at the joint after it is brazed. Feed a small quantity of muriatic acid all the small pieces of zinc it will consume, and dilute with the same quantity of soft water. Place a thin strip of silver solder between the ends and cover all with the flux. Heat to a bright cherry red a large pair of tongs with jaws long enough to reach across the width of the plate. Remove all scale and clamp the lap between the jaws and have a helper clasp the farther ends with another pair and squeeze tightly until the plate be sufficiently heat; then gradually pull off the hot tongs, following up with another pair slightly warmed. When cooled, if properly done, the splice will have a temper equal to that of the plate. File off all surplus solder, smooth off the lap and the plate is ready for use.

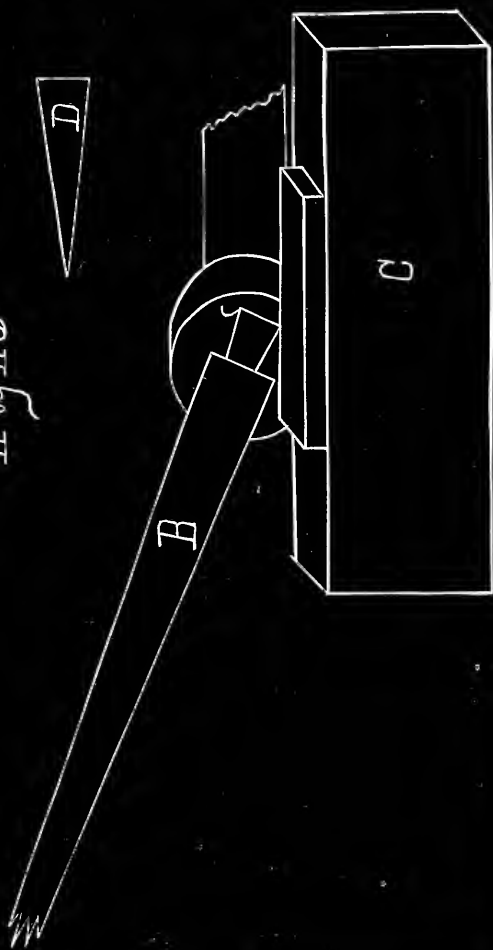
Fig 18



♣ruing Up Collars.

Many good saws are condemned simply from the want of truth in the mandrel. A mandrel, although perfect when new, will sometimes become imperfect and out of true by constant use. Frequently heating the bearing next to the fast collar will almost invariably cause the collars to become out of true, and if the saw and mandrel be subjected to hard strain the collars will be more or less effected. It takes but a slight variation at the center of a large circular saw to cause a considerable at the rim. Oftentimes these defects in the mandrel which cause unfaithfulness on the part of the saw is misleading, and many times the sawyer is puzzled to know what to do next as he has vented all of his skill upon the saw, thinking the fault lay with it. The collars may be effectually tested in the following manner: Form a steel turning tool as shown in Fig. 19, at D; give it a temper of light gold color and insert it into a wooden handle as shown at B. Leave the mandrel in its bearings and build up a solid rest under the fast collar as shown at C. Have a helper turn the mandrel slowly with the belt removed, while with the tool held firmly in the hands the operator may remove any variation upon the collar. If this be done carefully, providing the mandrel runs accurately in its bearings the collars will be again in good condition for use. The fast collar should have a bearing of about one-half inch at the rim with the center around the stud, hollowed out about one-thirty-second of an inch. The loose collar should be dressed perfectly flat upon its face and with the plate between will conform itself accurately with the other when the burr is tightened.

Fig 19



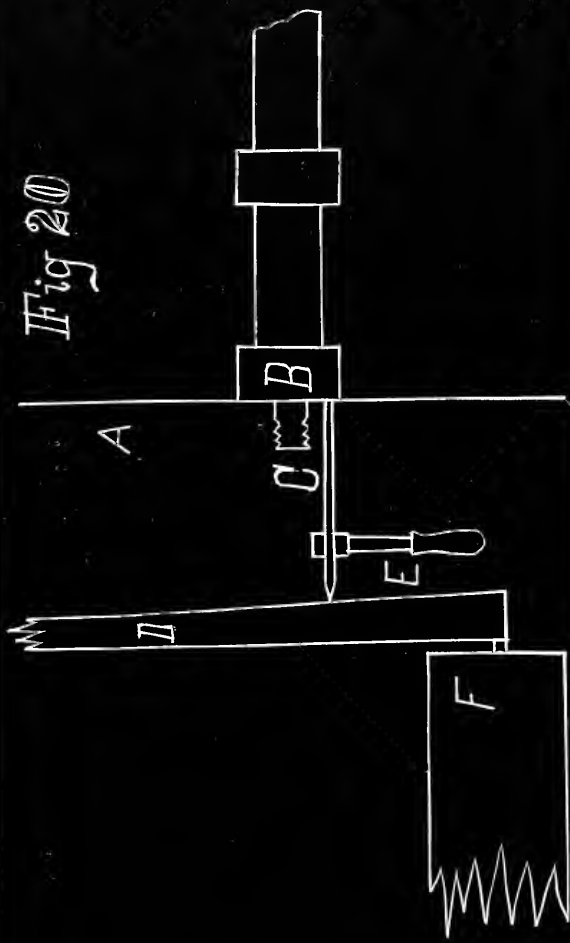
Lug Pins.

All large circular saws should be fitted upon their mandrels with two lug or stay pins to prevent the plate from slipping between the collars. If they are not fitted in this way when placed in the mill, or by accident are cut off, they may be drilled and fitted as follows: Build a rest as shown at F, Fig. 20, place the lower end of a lever D, against it and have a helper hold and press against the upper end. Place the drill, C, with point against saw and collar, A, B, to be drilled, and turn the drill hand over hand by a wrench as shown at E. A well tempered drill, supplied with a little oil, will soon cut through the plate and into the collar far enough to receive the pins. In placing the saw it should be turned back snugly against the pins before the burr is firmly tightened. This will prevent cutting them off in case the saw should catch or be bound in the cut.

HOT MANDRELS.

Many sawyers are frequently bothered by their plates heating at the center from a hot bearing. To prevent this, smooth and polish the bearing, remove the filling from the box and refill by using old type metal in place of poor friction babbitt that probably has mainly caused the difficulty. A true bearing well fitted in this manner, and supplied with good, heavy lubricating oil will give no more trouble.

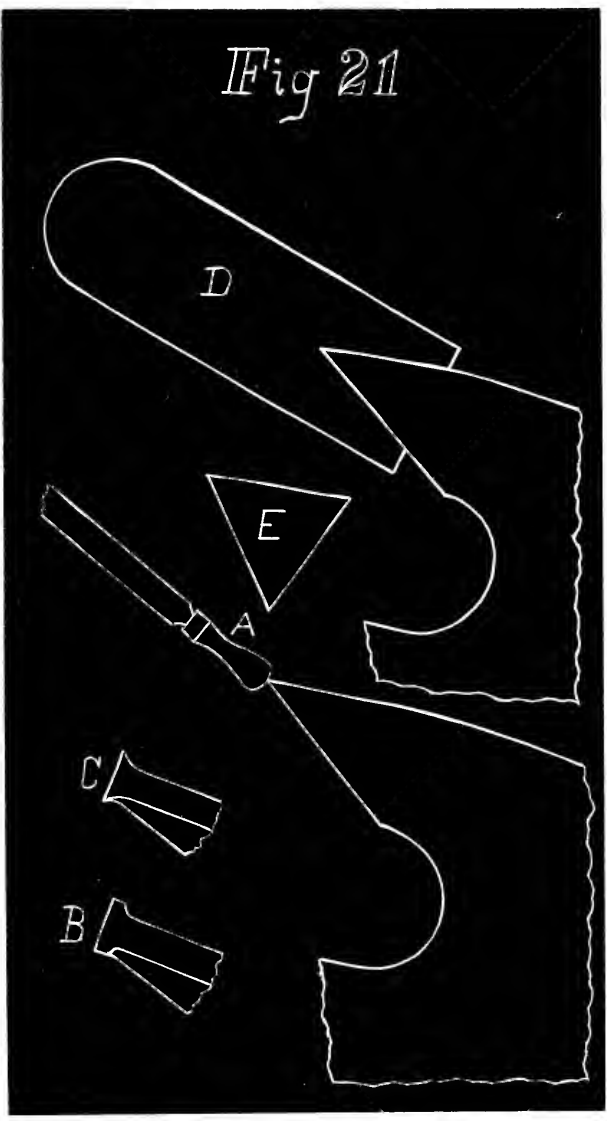
Fig 20



Filing and Swaging.

In filing a tooth, whether it be for cross-cutting or slitting, the filer should run his file perfectly flat and straight and not allow the ends to rock. A good square cutting edge cannot be obtained unless this be done and it requires practice to do it perfectly. The filer should not use larger than a ten-inch file for dressing the teeth upon the largest plates. If there is a surplus of metal to be removed it should be done with the gummer and not with the file. In dressing a tooth the feather edge should frequently be brushed off with a block or the end of file handle as shown at A, Fig. 21. This will prevent filing too deep and causing unevenness on the points of the teeth. A convenient form of gauge for dressing the teeth too, is shown at D. If dressed to the gauge the same pitch of tooth is always maintained. Case-hardened spots, caused by not gnmning properly, cannot be filed and should be removed by pressing lightly and quickly upon the wheel and removing before there is heat enough created to again chill or harden. In swaging teeth upon the thicker plates a swage should be used having a pitch equal to that of the template shown at E. At B and C is shown different ways of swaging out the points. The point shown at B is far preferable, as it has heavy corners to support the width of the cutting edge.

Fig 21



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